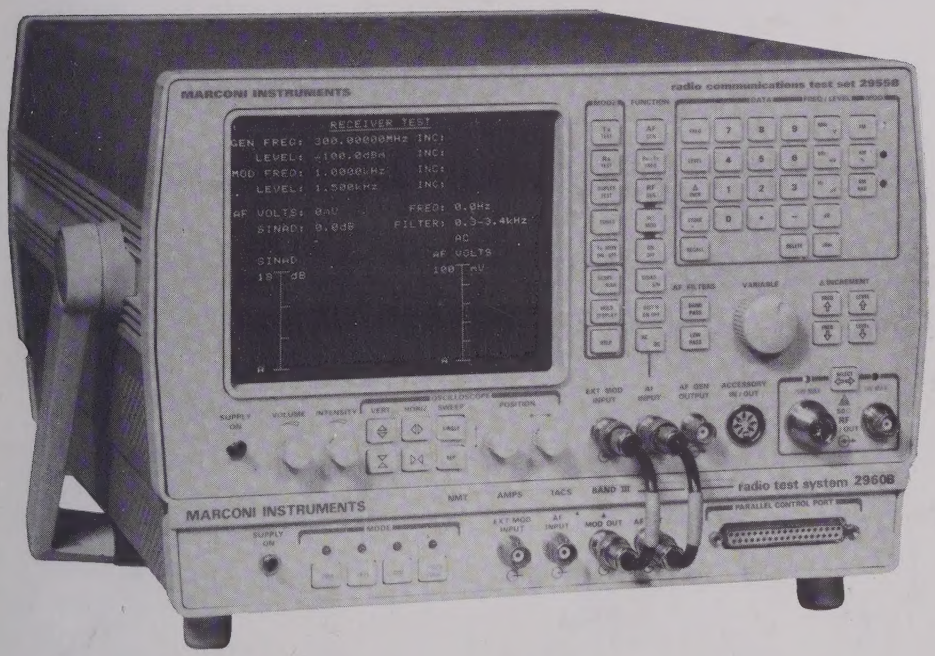
Marconi
Instruments

RADIO TEST SYSTEMS

2960 and 2960B



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MP MASTER
MA31141

Operating Manual

Marconi
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Operating Manual

H 52960-900R
Volume 1

RADIO TEST SYSTEMS

2960 and 2960B

Multi-system capability

2960 Part no. 52960-900R (with 2955)
52960-910U (with 2955A)
52960-321Z (with 2955R)
2960B Part no. 52960-500Y (with 2955B)

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Printed in the UK

Manual part no. 46881-900L
Issue 14

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ASSOCIATED PUBLICATIONS

Operating Manual Supplements	(See in the Preface and under 'Accessories' in Chap. 1.)
Programming Manual	Part no. 46881-930Y
Programming Manual Supplements	(See in the Programming Manual.)
Service Manual, 2960 Adapter	Part no. 46881-911T
Service Manual, 2955A and 2955R	Part no. 46881-954A

PREFACE

The Radio Test Systems 2960 and 2960B consist of a Radio Communications Test Set 2955 series with a Multi-system Adapter as follows:-

System type	System part no.	Test Set type
2960	52960-900R	2955
	52960-910U	2955A
	52960-321Z	2955R
2960B	52960-500Y	2955B

The Multi-system Adapter is common to all variants (except for colour) and includes software for one or more systems. The Adapter can accept up to six co-resident options. Four options are currently available as below. Each software version number for the 2960B is the same as that for the 2960.

Features which are common to all of the systems are described in this Operating Manual.

To describe features in which there are differences between systems, there is an Operating Manual Supplement for each system. The Supplement has the same number as the option as follows:-

Option no.	System	Supplement	
		No.	Part no.
10	NMT	10	46881-901J
20	AMPS	20	46881-902F
30	TACS	30	46881-903G
50	Band III	50	46881-905S

This Manual covers instruments which contain system software version 3 and which were manufactured from May 1991 (i.e. with serial no. prefixes after 132339). If any later version of software affects this Manual, a Change sheet will be supplied. Information on DSAT and DST is not applicable to instruments which were manufactured before May 1991.

Throughout this manual except for Fig. 1.1, references to the 2960 also apply to the 2960B.

AMENDMENT STATUS

Each page bears the date of the original issue or the date and number of the latest amendment. Any changes subsequent to the latest amendment are included on Manual Change sheets coded C1, C2 etc. .

HAZARD SYMBOLS

The following symbols appear on this equipment.

Symbol	Type of hazard	Reference in Manual
	Dangerous voltages	Page v
	Lithium battery	Page vi
	Cathode ray tube	Page vi
or	Static-sensitive components	Page vi
	Input overload	Page vi

WARNINGS, CAUTIONS AND NOTES

The following terms have specific meanings in this Manual.

WARNINGS contain information to prevent personal injury.

CAUTIONS contain information to prevent damage to the equipment.

Notes contain important general information.

OPERATING PRECAUTIONS

This product has been designed and tested in accordance with IEC Publication 348 - 'Safety Requirements for Electronic Measuring Apparatus'. To keep it in a safe condition and avoid risk of injury, observe the following **WARNING** notices. To avoid damage to the equipment, observe the **CAUTION** notices.

WARNING - ELECTRICAL HAZARDS

AC supply voltage

This equipment conforms with IEC Safety Class 1, meaning that it is provided with a protective earthing lead. To maintain this protection, the mains supply lead must always be connected to the source of supply via a socket with an earthing contact. Make sure that the earth protection is not interrupted if the supply is connected through an extension lead or an autotransformer.

Before fitting a non-soldered plug to the mains lead, cut off the tinned end of the wires. Otherwise, cold-flowing of the solder could cause intermittent contact.

Do not use the equipment if it is likely that its protection has been impaired as a result of damage.

Fuses

Note that there are supply fuses in both the live and neutral wires of the supply lead. If only one of these fuses were to rupture, certain parts of the equipment could remain at supply potential.

Make sure that only fuses of the correct rating and type are used for replacement. Do not use mended fuses or short-circuited fuse holders.

To provide protection against breakdown of the supply lead, its connectors (and filter if fitted), an external supply fuse with a continuous rating not exceeding 6 A should be used in the live conductor (e.g. fitted in the supply plug).

Removal of covers

Disconnect both the AC and the DC supplies from the 2955 and/or the Adapter before removing the covers so as to avoid the risk of exposing high-voltage parts. If any internal adjustment or servicing has to be carried out with the supply on, it must only be performed by a skilled person who is aware of the hazard involved.

Note that the SUPPLY switch on the Adapter does not disconnect the DC supply.

Remember that capacitors inside the equipment, including any supply filter capacitors, may still be charged after disconnection of the supply. Those connected to high-voltage points should be discharged before carrying out work inside the equipment.

This applies particularly to the EHT circuit for the cathode ray tube which must be discharged by repeatedly shorting the final anode lead to the chassis or by using a bleed resistor. The residual charge on the CRT itself should also be removed by shorting the anode connector to the chassis.

WARNING - OTHER HAZARDS

Parts of this equipment are made from metal pressings. Therefore, it should be handled with due care to avoid the risk of cuts or scratches.

Some of the components used in this equipment may include resins and other materials which give off toxic fumes if incinerated. Take appropriate precautions, therefore, in the disposal of these items.

A Lithium battery is used in this equipment. This presents two hazards:-

(i) As lithium is a toxic substance, the battery should in no circumstances be crushed, incinerated or disposed of in normal waste.

(ii) If the battery is rapidly charged or discharged, there is a risk of explosion. Take care, therefore, to avoid short-circuiting it.

Cathode ray tube. When exposing or handling the tube, take care to prevent implosion and possible scattering of glass fragments. Handling should only be carried out by experienced personnel and the use of a safety mask and gloves is recommended. A defective tube should be disposed of in a safe manner by an authorized waste contractor.

CAUTION - STATIC-SENSITIVE COMPONENTS

This equipment contains static-sensitive components which may be damaged by handling. Refer to the Service Manual for handling precautions.

CAUTION - INPUT OVERLOAD

When testing a transmitter, an input overload is indicated by the message 'REMOVE RF INPUT' and an audible warning. Failure to respond could result in damage to the equipment.

CAUTION - TILT FACILITY

When the instrument is in the tilt position, it is inadvisable, for stability reasons, to stack other instruments on top of it.

Chapter 1

GENERAL INFORMATION

INTRODUCTION

The Radio Test System 2960 consists of a Radio Communications Test Set 2955 series with a Multi-system Adapter. On the front panel identity strip, there is a label for each of the system options which has been fitted.

The 2960 provides DC, audio and RF test facilities for testing cellular and trunked mobile radios and it provides the signalling for base station simulation. The 2955 and the Adapter are fitted together to form one transportable instrument.

On powering up, the 2960 behaves like a normal 2955. This is indicated by a LED above the Adapter's 2955 key. To invoke the 2960 operating modes, the Adapter's CRTS key is pressed. The first time that this is selected after each power-on, a self test and calibration sequence is initiated. This ensures that the 2955 and the Adapter are functioning correctly.

Fig. 1-1 Radio Test System 2960

Operating modes

The 2960 offers three modes of operation as follows:-

(a) GO/NO-GO TEST.
(b) FULL AUTO TEST.
(c) MANUAL TEST.

The GO/NO-GO TEST mode offers the user a rapid start to running a sequence of test routines. The results are summarized on the screen as a single line of information per test routine. If necessary, the display scrolls. However, the failed results remain on the display. This eliminates the need for continuous attendance.

Most of the selections and settings are set up in the FULL AUTO TEST mode. This mode offers the user a series of easy menus which allow many of the parameters, the sequence of test routines, the display and the 2960's interfaces to be altered. Sets of settings can be stored or recalled in this mode allowing rapid changes to be made between mobile types and system options. A sequence of test routines can then be run in this mode.

The MANUAL TEST mode offers manual control of the 2960's base station simulation. This is particularly useful when fault-finding or adjusting.

The 2955 mode can be selected at virtually any point of the 2960's operation. This allows all of the 2955 measurements to be made. Signals are maintained to ensure that the mobile remains in conversation.

If more than one system option is installed in the 2960, then a system selection menu is offered to allow simple change over between systems.

Test sequences

For the GO/NO-GO TEST mode and the FULL AUTO TEST mode, the 2960 automatically executes a chosen test sequence. There is a choice of four built-in sequences.

The combination of selectable test modes and test sequence gives a great degree of flexibility and allows the user to define an area and depth of testing.

In addition to the four built-in test sequences, the user can define his own test sequences. This is done using a learn mode in remote control using the GPIB or through the RS-232 port. One user-defined test sequence can be stored within the instrument in non-volatile memory. Up to ten of them can be stored on a floppy disc when a disc drive is connected.

Test routines

Each test sequence consists of a number of individual test routines. As many of the test routines are system specific, they are detailed in the Option Supplements.

Pause facility

For when it is necessary to diagnose a fault or to carry out repairs and alignment, the 2960 provides a pause facility. This shows simultaneously the transmitter and receiver RF and AF parameters and the current test results.

When the 2960 is in the paused condition, the 2955 can be selected. This allows manual control for alignment and fault finding purposes.

Displays of signalling data

Another feature of the 2960 is the ability to look at the signalling data which is sent between the mobile and the 2960. Thus, the signalling data transmitted and received by the mobile can be seen and each frame can be examined in detail.

Standard interfaces

The Adapter carries GPIB, RS-232, Centronics parallel and disc interface connectors. The GPIB port or the RS-232 port can be connected to an external controller to form a sophisticated ATE system. Alternatively, one of these or the Centronics parallel port can be used to drive a printer. The disc interface port is compatible with a 5.25 or 3.5 inch single-sided or double-sided disc drive. The disc drive can be used to down-load previously-written user-defined test sequences.

PERFORMANCE DATA

User controls	Four mode keys as below.
2955	Selects normal 2955 operation.
CRTS	Selects cellular (and trunked) radio test system mode.
DISC	Selects disc menu.
PSOPH	Selects psophometric filter. Selects local when in remote.
DC power meter	
Voltage range	1 to 25 V.
Voltage accuracy	±5% ±100 mV.
Current range	0 to 10 A.
Current accuracy	±5% ±200 mA.
Power accuracy	±10% ±20 mW, 100 mW to 200 W.

AF input to AF output

As 2955 except AC coupling only and x20 amplifier for <100 mV.

External modulation input

0.5 V pk-pk for 5 kHz deviation ±10% at 1 kHz.

AF measurement de-emphasis

Frequency response: 6 dB/octave, 300 Hz to 3.4 kHz.

Psophometric (CCITT) filter

CCITT filter selectable for psophometric audio measurements.

Frequency response: Conforms to CCITT Recommendation P53.

Tolerances

50 to 300 Hz	±2 dB.
300 to 800 Hz	±1 dB.
800 Hz reference	0 dB.
800 Hz to 3 kHz	±1 dB.
3 to 3.5 kHz	±2 dB.
3.5 to 5 kHz	±3 dB.

Psophometric (C-message) filter

C-message filter selectable for psophometric audio measurements.

Frequency response

Relative to 1 kHz reference.

60 Hz	55.7 ±2 dB.
100 Hz	42.5 ±2 dB.
200 Hz	25.0 ±2 dB.
300 Hz	16.5 ±1 dB.
400 Hz	11.4 ±1 dB.
500 Hz	7.5 ±1 dB.
600 Hz	4.7 ±1 dB.
700 Hz	2.7 ±1 dB.
800 Hz	1.5 ±1 dB.
900 Hz	0.6 ±1 dB.
1 kHz	0.0 dB reference.
1.2 kHz	0.2 ±1 dB.
1.3 kHz	0.5 ±1 dB.
1.5 kHz	1.0 ±1 dB.
1.8 kHz	1.3 ±1 dB.
2 kHz	1.3 ±1 dB.
2.5 kHz	1.4 ±1 dB.
2.8 kHz	1.9 ±1 dB.
3 kHz	2.5 ±1 dB.
3.3 kHz	5.2 ±2 dB.
3.5 kHz	7.6 ±2 dB.
4 kHz	14.5 ±3 dB.
4.5 kHz	21.5 ±3 dB.
5 kHz	28.5 ±3 dB.

Thereafter, attenuation to increase at 12 dB/octave until it reaches 60 dB.

SAT generation		
	Frequency range	3 to 8 kHz in 5 Hz steps, normally 4 or 6 kHz.
	Frequency accuracy	Crystal derived, better than ±1 Hz (at SAT frequencies).
	Output level accuracy	±10%, 300 Hz to 2.5 kHz at system frequencies, i.e. 3.955 to 4.045 kHz and 5.970 to 6.030 kHz.
	Distortion	<3%. <2% at 4 kHz ±45 Hz. <2% at 6 kHz ±30 Hz.
SAT measurement		
	Accuracy	±10% at nominal system SAT frequencies and levels.
ST measurement		
	Measurement accuracy	±10% at 5 to 10 kHz.
	Tone duration	±10 ms at 40 ms to 5 s.
FFSK data		Phase-continuous frequency-shifted tones of 1200 and 1800 Hz.
	Generated data deviation	±10% at 1 to 4 kHz.
	Bit rate	1200 baud ±1 bit/s.
	Measurement deviation	±10% at 1 to 10 kHz.
FSK data		Manchester encoded NRZ.
	Generated data deviation	±10% at 1 to 10 kHz.
	Bit rate	±1 bit/s at 8 or 10 kHz.
	Measurement deviation	±10% at 1 to 10 kHz.
DTMF tone generation		
	Frequency accuracy	±1 Hz at DTMF frequencies.
	Deviation	±10% for 1 to 5 kHz high tone. Low tone equal to high tone ±2 dB.
	Distortion	<3% (individual tones).

Digital SAT and ST generation	Sub-audible FSK data, Manchester encoded and bandwidth limited.
Data rate	200 bit/s.
Data rate accuracy	±0.01 bit/s.
Deviation range	0 to 1 kHz.
Deviation accuracy	±10% at 700 Hz.
Digital SAT and ST measurement	
Deviation accuracy	±10% at nominal system level (700 Hz).
Printers	
Printer interfaces	RS-232, GPIB and Centronics.
Print menu facilities	Print on PASS, FAIL, ALWAYS.
Control interfaces	
GPIB	IEEE488 subset SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E1.
RS-232	All standard rates 75 to 9600 baud. Length/parity 8 even, odd, none; 7 even, odd, none. Stop bits 1,2.
Parallel	Parallel printer (Centronics type). 8-way bi-directional port. 48 mA sink. 4 TTL outputs (unprotected). 4 TTL inputs (unprotected) +5 V DC supply at 100 mA accessory power (unprotected). 3 analogue inputs routed to AF INPUT of 2955, maximum 10 V peak, impedance >1 MΩ (accessible through GPIB).
Disc interface	
Format	Compatible with 3.5 or 5.25 inch, 40 or 80 track, single-sided or double-sided, single density disc drive with industry standard S.400 (Shugart) controller drive interface. Track to track step time selectable from 6 or 12 ms.
Connector	34-way IDC male socket.

Power requirements, AC	
Rated supply voltage	115 V or 230 V nominal AC.
Supply voltage range	95 to 130 V or 190 to 264 V AC.
Supply frequency range	50 to 400 Hz ±10%.
Consumption	30 VA.
Power requirements, DC	
Supply voltage	±11 to 32 V.
Consumption	30 W maximum.
Dimensions and Weight	
Height	231 mm (9.1 in)
Width	345 mm (13.6 in)
Depth	490 mm (19.3 in)
Weight	20.0 kg (44 lb)
Safety	Complies with IEC 348 safety requirements.
Environmental	
Limit range of operation	0 to 55°C.
Rated range of use	0 to 50°C.
Conditions of storage and transport	
Temperature	-40 to +70°C.
Humidity	Up to 90% RH.
Altitude	Up to 2500 m (pressurized freight at 27 kPa differential (3.9 lbf/ in²).
Radio frequency interference	Conforms to the requirements of EEC Directive 76/889 as to limits of RF interference.

ACCESSORIES

Supplied	Part no.
Operating Manual	46881-900L
Programming Manual	46881-930Y
Fixing kit	46883-879M
Stowage cover assembly	41690-495E

Optional

System option kits (consisting of ROM IC, labels, Operating Manual Supplement and Programming Manual Supplement) as follows:-

Option no.	System	Kit part no.
10	NMT	46884-101J
20	AMPS	46884-102F
30	TACS	46884-103G
50	Band III	46884-105S

At least one of these options is fitted. All four can be fitted together. There is provision for six options to be fitted.

Service Manual, 2960 Adapter	46881-911T
Service Manual, 2955A and 2955R	46881-954A
Primary pack	37136-582V
DC supply cable kit	46883-907V
Cable assembly, N to TNC	43130-596E
Cable assembly, parallel control port to Centronics	43130-592K
Cable assembly, serial port to standard RS-232	43130-593A
Custom Test Software Package	44991-064D

Chapter 2

INSTALLATION

UNPACKING AND REPACKING

Retain the container, packing material and the packing instructions note (if included) in case it is necessary to reship the instrument.

If the instrument is to be returned for servicing, attach a label indicating the service required, type or model number (on rear label), serial number and your return address. Pack the instrument in accordance with the more detailed information which is given in the packing instruction note or as follows:-

(1) Place the mains lead in a suitable plastic bag and tape it to the instrument rear panel.

(2) Place the instrument within its plastic cover.

(3) Ensure that the padded fitting is in place within the inner carton and slide the instrument in, rear panel first, leaving the front panel exposed at the open end.

(4) Fit the separate front panel protecting cover over the panel and close and seal the inner carton.

(5) Place one of the moulded plastic cushions in the bottom of the outer carton and insert the inner carton so that it locates in the cushion recess.

(6) Place the remaining plastic cushion over the other end of the inner carton and close and seal the outer carton.

(7) Wrap the container in waterproof paper and secure with adhesive tape.

(8) Mark the package FRAGILE to encourage careful handling.

Note...

If the original container or materials are not available, use a strong double-wall carton packed with a 7 to 10 cm layer of shock-absorbing material around all sides of the instrument to hold it firmly. Protect the front panel controls with a plywood or cardboard load spreader.

MOUNTING ARRANGEMENTS

Excessive temperatures may affect the instrument's performance. Avoid standing the instrument on or close to other equipment that is hot.

TEST SET INTERCONNECTIONS

If the instrument received is a complete Radio Test System 2960, it only requires connection to the power supply and the peripherals to be fully operational.

Note...

On the 2955's GPIB interface unit, check that the 2 and 4 switches are set on (not OPEN) to give an address of 6 (or any other address in the range 1 to 30) and that the TALK ONLY switch is set to OPEN. See Fig. 2-3.

If the instrument received is a Multi-system Adapter for converting an existing Radio Communications Test Set 2955 to a Radio Test System 2960, follow the procedure below. First, make sure that the 2955 is fitted with a GPIB interface unit.

Converting a 2955 to a 2960

The 2960 consists of a Multi-system Adapter and a 2955 which are assembled together. See Fig. 2-1 and Fig. 2-2. Proceed as follows:-

(1) Unpack the Multi-system Adapter and check that the accompanying Fixing Kit 46883-879M contains the items given in Table 2-1. If any part is missing, contact your nearest Marconi Instruments representative. (For the address, see the rear cover).

(2) Turn the 2955 upside down and lever off the caps covering the screws which hold the feet in place. Save the caps.

(3) Unscrew and remove the 4 feet. Save the screws.

(4) Insert the 4 clips (items 5 and 6) in the slots in the positions formerly occupied by the feet. The clips are handed. Lay them flat and positioned so that the screw holes in the clips line up with the screw holes in the 2955's bottom cover.

(5) In place of the 4 feet, screw in the 4 pillar assemblies (item 4).

TABLE 2-1 FIXING KIT CONTENTS

Item	Description	Part no.	Quantity
1	Cable assembly, BNC connectors, 0.13 m	43130-498L	2
2	Cable assembly, BNC connectors, 0.26 m	43130-499J	1
3	Mains cable assembly	43137-364J	1
4	Pillar assembly	41700-616V	4
5	Clip (right-hand)	35905-447D	2
6	Clip (left-hand)	35905-448T	2
7	Rear support bar	41700-639Y	2
8	Screw pan head M4 x 8	21837-459D	2
9	Screw pan head M4 x 12	21837-463T	2
10	Crinkle washer M4	21177-650H	4

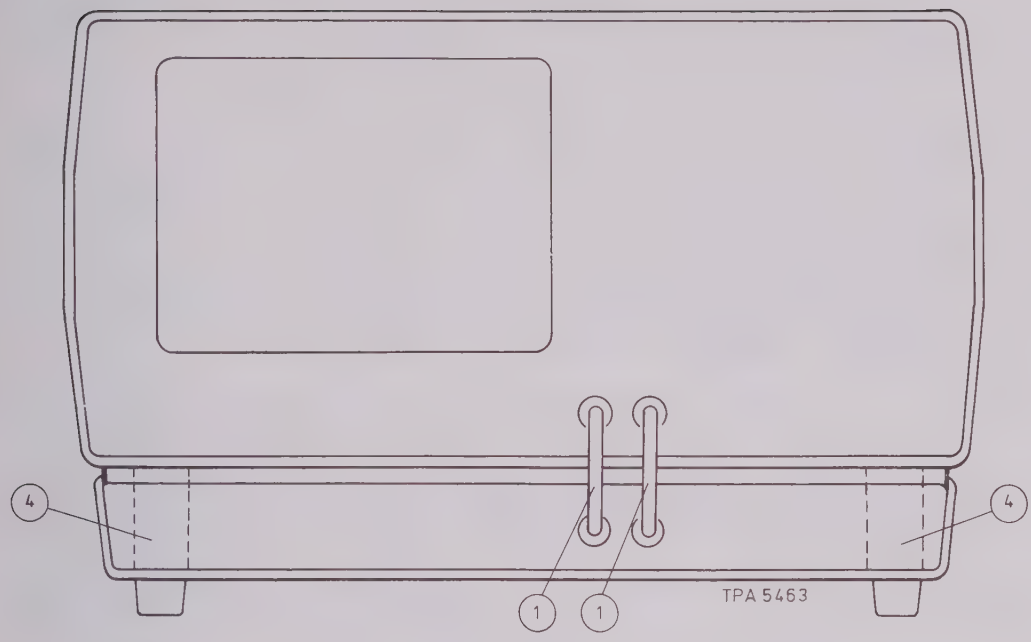

Fig. 2-1 Front view showing electrical and mechanical connections (item numbers as given in Table 2-1)

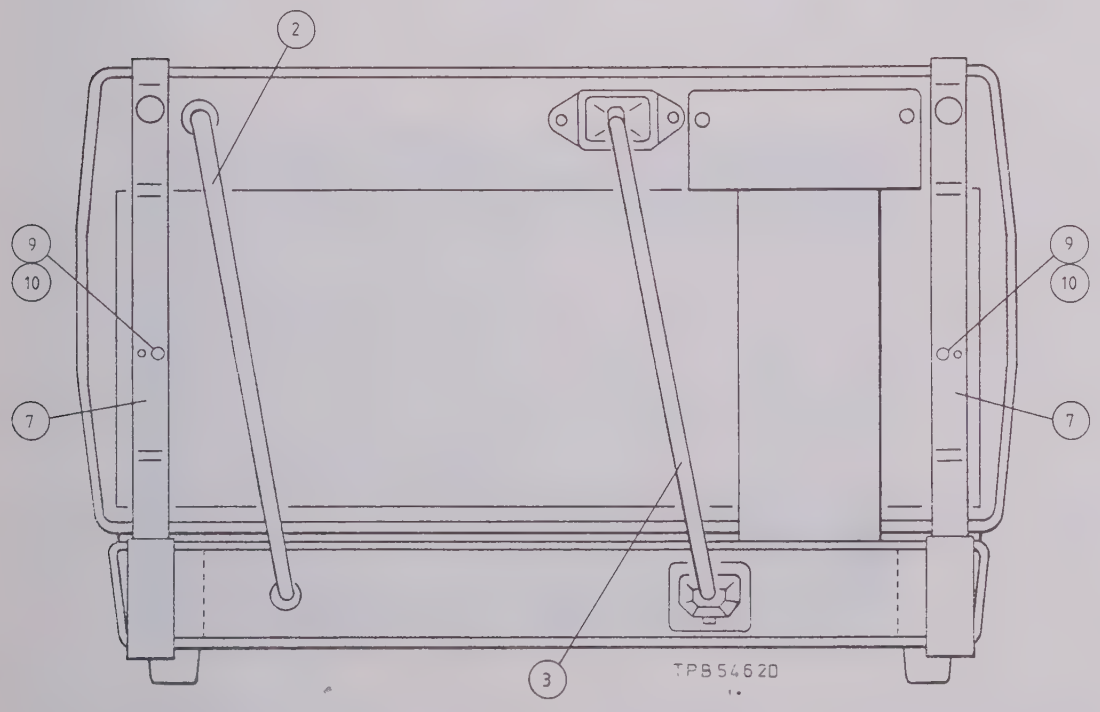

Fig. 2-2 Rear view showing electrical and mechanical connections (item numbers as given in Table 2-1)

(6) With the 2955 upside down, position the Adapter, also upside down, over it so that the pillars on the 2955 enter the 4 cutouts in the Adapter without trapping any of the cables. At this point, both instruments should line up all the way round.

(7) Screw the 4 feet into the ends of the pillar assemblies.

(8) Replace the caps.

(9) On the 2955, remove the 2 screws which retain the rear cover. Discard the screws.

(10) Hook the curved ends of the 2 rear support bars into the slots in the 2955's upper 2 rear feet.

(11) Screw the other ends of the bars into the Adapter's rear casting using the 2 shorter M4 screws (item 8) with washers (item 10).

(12) Insert the 2 longer screws (item 9) with washers (item 10) through the rear support bars (using the inside holes) into the rear cover screw holes.

(13) Finally, check that both instruments are securely held together. This completes the mechanical connection.

(14) Connect the Adapter's MOD OUT socket to the 2955's EXT MOD INPUT socket using one of the 0.13 m coaxial cable assemblies (item 1).

(15) Connect the Adapter's AF OUT socket to the 2955's AF INPUT socket using the second of the 0.13 m coaxial cable assemblies (item 1).

(16) Connect the Adapter's IF IN socket to the 2955's IF OUT socket using the 0.26 m coaxial cable assembly (item 2).

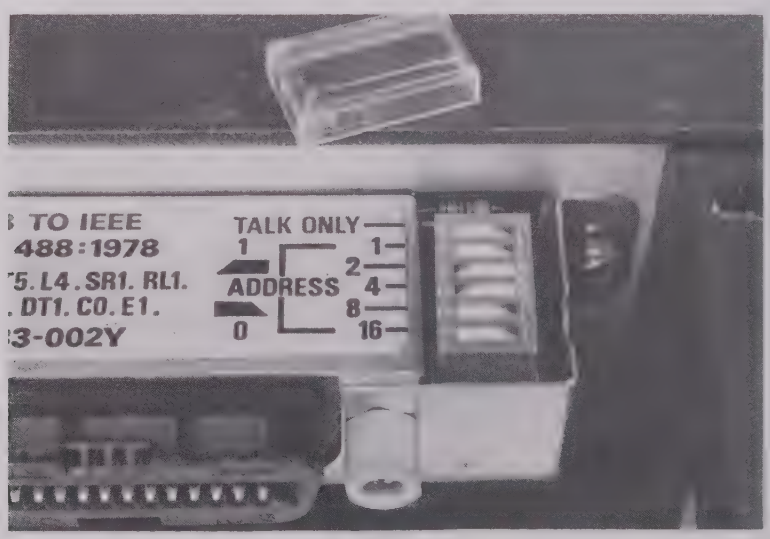

Fig. 2-3 Switches on the 2955's GPIB interface unit set to address 6 (2 + 4) and not to TALK ONLY

(17) Connect the Adapter's AC SUPPLY OUT socket to the 2955's AC SUPPLY socket using the mains cable assembly (item 3).

(18) Connect the Adapter's internal GPIB ribbon cable to the 2955's GPIB connector and fasten it using the lock screws provided.

(19) On the 2955's GPIB interface unit, set the 2 and 4 switches to on (not OPEN) to give an address of 6 (or set any other address in the range 1 to 30). Set the TALK ONLY switch to OPEN. See Fig. 2-3.

(20) Finally, switch both the Adapter and the 2955 on after ensuring that both voltage selectors are set to the correct range with correct fuses fitted. Check that the GPIB address is correct. Press the CRTS key and check that the self test sequence commences.

SAFETY TESTING

Where safety tests on the AC supply input circuit are required, the procedures below can be applied. These comply with BS4743 and IEC348. Tests are to be carried out as follows and in the order given, under ambient conditions, to ensure that AC supply input circuit components and wiring (including earthing) are safe:-

(1) **Earth lead continuity test** From any part of the metal frame to the bared end of the flexible lead for the earth pin of the user's AC supply plug. Preferably a heavy current (about 25 A) should be applied for not more than 5 seconds. The test limit is not greater than 0.5 Ω.

(2) **500 V DC insulation test** From the AC supply circuit to earth. The test limit is not less than 2 MΩ.

AC POWER SUPPLY REQUIREMENTS

Each of the two instruments comprising a 2960, the 2955 and the Adapter, requires 105 to 120 V or 210 to 240 V AC, 50 to 400 Hz. For the Adapter, the required supply fuses (time lag) are 500 mA for 105 to 120 V or 250 mA for 210 to 240 V. Before switching on, ensure that the rear panel voltage range switches are in their correct positions as revealed by the cut-outs in the locking plates and that the correct value fuses are fitted. To change a mains voltage setting, reverse the locking plate after setting the slide switch to its alternative position. Ensure that the Adapter and the 2955 are both set to the same voltage range and that the mains cable assembly is fitted between the Adapter's AC SUPPLY OUT and the 2955's AC SUPPLY connectors.

The mains cable assembly is fitted at one end with a female plug which mates with the AC connector at the rear of the Adapter. When fitting a supply plug, ensure that the connections are as follows:-

Earth (ground)	- Green and yellow
Neutral	- Blue
Live (phase)	- Brown

When attaching the mains cable to a non-soldered plug, it is recommended that the tinned ends of the lead are first cut off to avoid the danger of cold flowing of any solder which could result in intermittent connection.

DC POWER SUPPLY REQUIREMENTS

Applicable to instruments with serial number prefix 131972 or over.

Connect ±11 to 32 V to the left-hand red (live) and black (chassis) terminals on the rear.

GENERAL PURPOSE INTERFACE BUS

Internal GPIB connection

The 2960 only operates with the internal GPIB cable connected between the Adapter and the 2955 GPIB connector. See Fig. 2-3.

External GPIB connection

Connection to other equipment is made using the Adapter's rear panel IEEE488 24-way connector. For this purpose, a GPIB cable assembly is available as an optional accessory. An optional IEEE-to-IEC adapter is available for connecting to systems which use a 25-way bus connector to IEC Recommendation 625. See Fig. 2-4.

GPIB connector contacts

The contacts on the GPIB cable connector and the device connector are as shown in Fig. 2-5.

The cables have male-female connectors at both ends. This allows several connectors to be stacked one on top of another and secured by a lockscrew mechanism. However, there might be damage with too large a stack. The stacking arrangement permits star or linear interconnection between the devices forming a system with the restriction that the total cable length for the system is not greater than 20 m (65 ft) and also not greater than 2 m (6 ft) times the total number of devices (including the controller) connected to the bus.

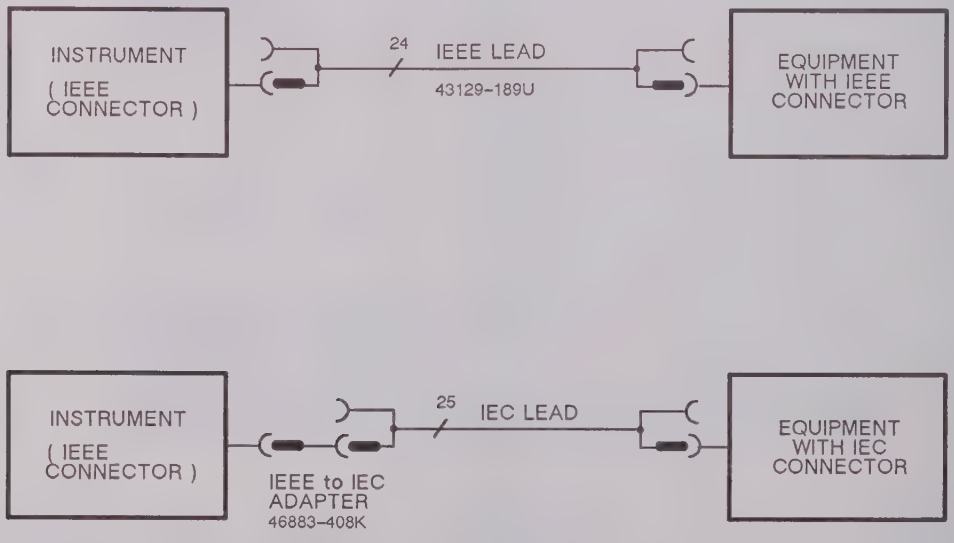

Fig. 2-4 GPIB interconnections

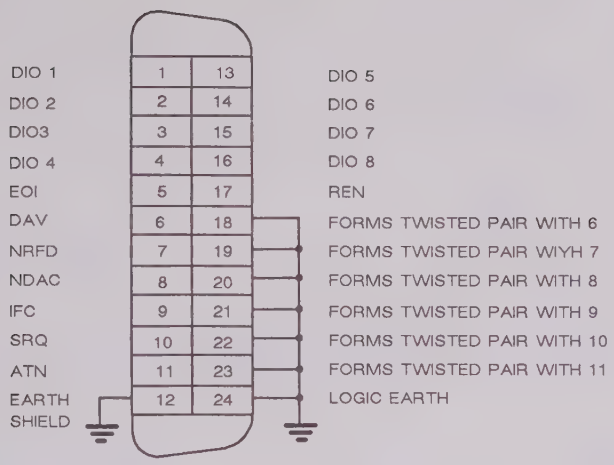

Fig. 2-5 GPIB connector contacts

SERIAL PORT

The contacts of the serial port 15-way connector are shown in Fig. 2-6. Contact functions are given in Table 2-2.

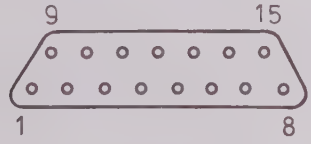

Fig. 2-6 Serial port connector contacts
(as viewed from the side of the instrument)

TABLE 2-2 SERIAL PORT CONNECTOR CONTACTS

Contact	Function	Contact	Function
1	Rx data, TTL	9	RTS, RS-232
2	Earth	10	Earth
3	Rx data, RS-232	11	RTS, TTL
4	Earth	12	Earth
5	Tx data, TTL	13	CTS, RS-232
6	Earth	14	+5 V out
7	Tx data, RS-232	15	CTS, TTL
8	Earth		

A serial port to standard RS-232 cable assembly, available as an optional accesssory, is shown in Fig. 2-7.

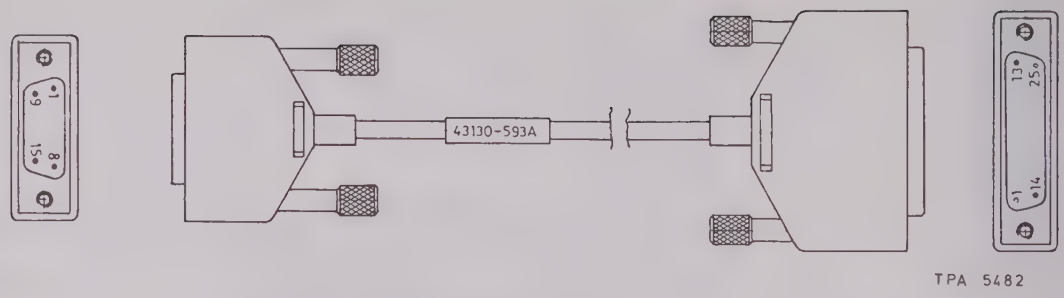

Fig. 2-7 Serial port to standard RS-232 cable connector contacts (looking into the connectors)

PARALLEL CONTROL PORT

The contacts of the parallel control port 37-way connector are shown in Fig. 2-8. The functions of the contacts are given in Table 2-3.

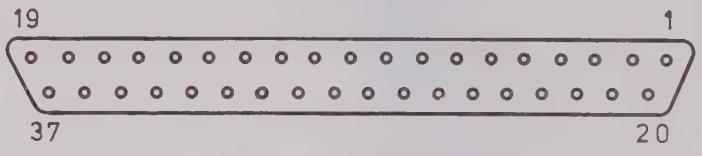

Fig. 2-8 Parallel control port connector contacts (as viewed from the front of the instrument)

TABLE 2-3 PARALLEL CONTROL PORT CONNECTOR CONTACTS

Contact	Function	Contact	Function
1	+5 V out	20	Earth
2	User input 2	21	User input 1
3	User input 4	22	User input 3
4	Modulator input	23	RSSI input
5	I/O control strobe L	24	Discriminator input
6	Data 7	25	Data 8
7	User output 2	26	Data 6
8	User output 3	27	Earth
9	Data 5	28	User output 1
10	Data 3	29	Data 4
11	Data 1	30	Data 2
12	I/O control ACK L	31	I/O control
13	User output 4	32	I/O control
14	Earth	33	Earth
15	Earth	34	Earth
16	Voltmeter input	35	Voltmeter input
17	Not connected	36	Not connected
18	Not connected	37	Not connected
19	Not connected		

A parallel control port to Centronics cable assembly, available as an optional accessory, is shown in Fig. 2-9. The contacts for the D-type connector to the 2960 and the type 57 connector to the printer are shown in Fig. 2-9. The functions of the contacts are shown in Table 2-4.

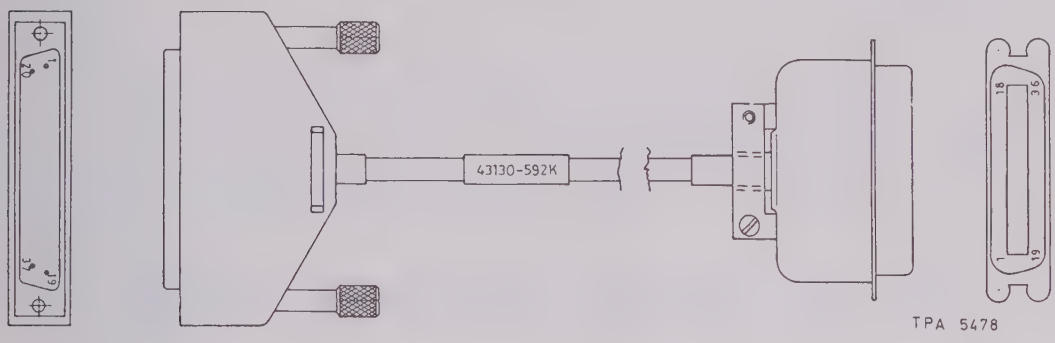

Fig. 2-9 Parallel control port to Centronics cable connector contacts (looking into the connector)

TABLE 2-4 PARALLEL CONTROL PORT TO CENTRONICS CABLE CONNECTOR CONTACTS

D type connector contact (2960)	Printer function	Type 57 connector contact (printer)
5	Strobe L	1
6	Data 7	8
9	Data 5	6
10	Data 3	4
11	Data 1	2
12	ACK L	10
14	Earth	19 and 26
15	Earth	22 and 23
25	Data 8	9
26	Data 6	7
27	Chassis	17
29	Data 4	5
30	Data 2	3
33	Earth	20 and 21
34	Earth	24 and 25

DISC INTERFACE PORT

The contacts of the disc interface 34-way connector are shown in Fig. 2-10. When a non-polarized connector is used, ensure that contact 1 (arrow marking and/or stripe on cable) is to the front. Contact functions are given in Table 2-5.

Fig. 2-10 Disc interface connector contacts
(as viewed from the side of the instrument)

TABLE 2-5 DISC INTERFACE CONNECTOR CONTACTS

Contact	Function	Contact	Function
1	Unused	2	Unused
3	Unused	4	Unused
5	Unused	6	Unused
7	Earth	8	Index
9	Earth	10	DS0
11	Earth	12	DS1
13	Unused	14	Unused
15	Earth	16	Motor on
17	Earth	18	Direction
19	Earth	20	Step
21	Earth	22	Write data
23	Earth	24	Write gate
25	Earth	26	Track 00
27	Earth	28	Write protect
29	Earth	30	Read data
31	Earth	32	Side select
33	Unused	34	Unused

Chapter 3-1

OPERATION

INTRODUCTION

The 2960 is a combined instrument which consists of a Radio Communications Test Set 2955 series and a Multi-system Adapter. This chapter describes features which are common to all of the systems. For details of the features in which there are differences between the systems, see the appropriate Operating Manual Supplement.

As this chapter describes the operation of Radio Test System 2960, the operation of the 2955 is not explained except where pertinent. Full details of 2955 operation are given in the Operating Manual for the 2955.

INDICATORS, CONTROLS AND CONNECTORS

2960 front panel

See Fig. 3-1.

(1) SUPPLY switches. When both switches are set to ON, power is supplied through the rear panel AC SUPPLY IN connector (21) to the Adapter, and from the AC SUPPLY OUT connector (22) through the AC SUPPLY connector (26) to the 2955. Note that the Adapter's SUPPLY switch does not control power to the AC SUPPLY OUT connector as it is wired directly to the AC SUPPLY IN connector.

(2) 2955 MODE key. Selects the normal mode of operation of the 2955. During this mode, the Adapter is mainly passive. When 2955 mode is selected and the Adapter is in conversation mode and sending or generating data, the CRTS indicator LED remains on. This is to remind the user that modulation generated by the 2955 is combined with these signals. To disable these signals, press the 2955 key again. If the 2955 mode is selected when the system is in remote, on the GPIB or the RS-232 interface, any modulating signals are removed immediately to ensure a fast flow of data through the Adapter.

(3) CRTS MODE key. Selects the Radio Test System mode of operation with the Adapter controlling the 2955. When this key is first pressed after power-on, the instrument commences its self test and calibration sequence. This is omitted on subsequent key presses. When this key is pressed immediately following 2955 operation, the 2960 returns to the menu previously selected (if permissible). It can also be used to abort a particular test sequence and to return to the top level menu at any time.

(4) DISC MODE key. Selects a menu which permits user-defined sequences to be loaded and saved using an accessory disc drive. This key is enabled when one of the top level system menus is being displayed.

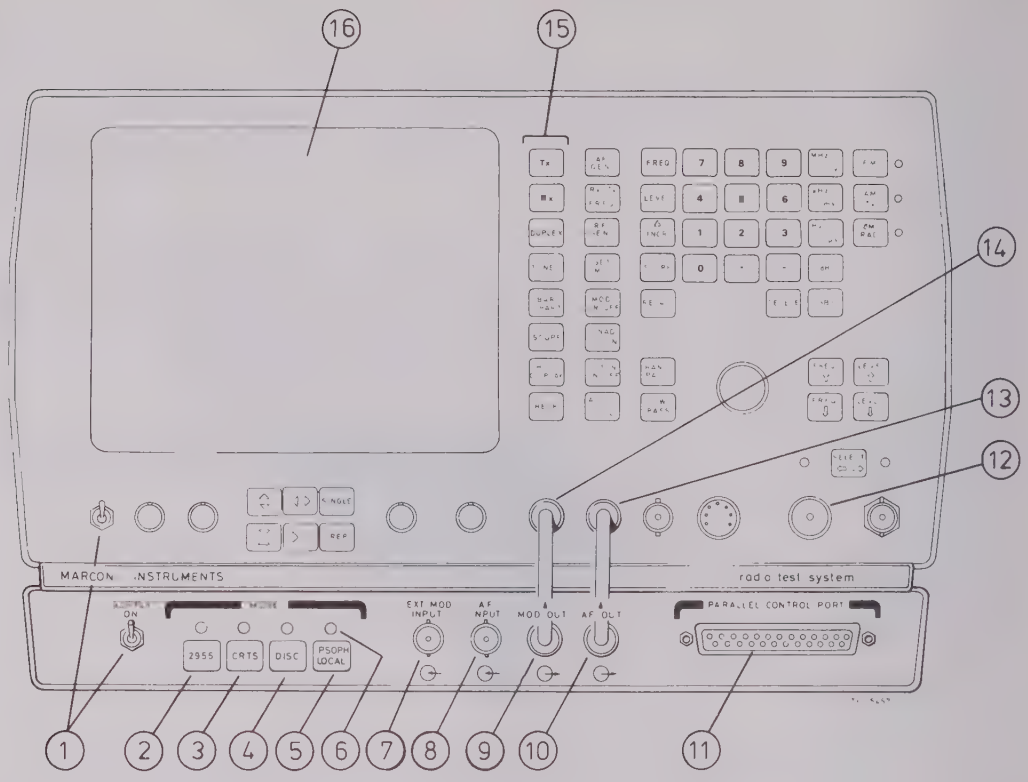

Fig. 3-1 2960 front panel

(5) PSOPH/LOCAL MODE key. The PSOPH key function is only enabled during 2955 local operation. It toggles between removal and insertion of the psophometric filter in the AF input path. When the filter is inserted, the LED above the key is lit. The LOCAL key function is only enabled during remote operation (unless GPIB local lockout asserted). It switches control from remote to local as shown on the display.

(6) MODE key LEDs. These light to indicate that the selected mode is enabled and functioning. One or more LEDs flashing indicates a fault condition as follows:-

LED	Fault
All	Volatile RAM fault.
2955	2955 not responding.
CRTS	ROM fault.
DISC	Non-volatile RAM fault.
PSOPH	System option ROM fault.

Flashing of the CRTS, DISC or PSOPH LED can be cancelled by pressing another of the Adapter's MODE keys. If either CRTS or DISC is then pressed and the associated LED flashes, this indicates that the 2955 is not connected or not addressable. Switch the instrument off and on again after the fault has been corrected.

(7) EXT MOD INPUT socket. BNC socket for the application of an external modulation source when this is required for additional tones signalling. Also used for an external demodulated source when selected from the MISCELLANEOUS menu. This enables data signals to be sent to the 2960's modems without being modulated on a carrier. This is useful for testing logic boards.

(8) AF INPUT socket. BNC socket for audio signals from the mobile. The input is AC coupled.

(9) MOD OUT socket. BNC socket for connection to the 2955's EXT MOD INPUT socket (14). Modulates the 2955 signal generator with serial data and tones.

(10) AF OUT socket. BNC socket for connection to the 2955's AF INPUT socket (13).

(11) PARALLEL CONTROL PORT connector. Used for connection to a Centronics or parallel type printer or for automatic control of mobile interfaces.

(12) RF IN/OUT socket. N socket for the RF input. 50 Ω impedance.

(13) AF INPUT socket. BNC socket for the AF output from the Adapter's AF OUT socket (10).

(14) EXT MOD INPUT socket. BNC socket for the modulating output from the Adapter's MOD OUT socket (9).

(15) Soft keys. When in CRTS mode, these are used as soft keys to select a programmed function. The function is displayed on the screen alongside the activating key.

(16) Display. Used to display the operating menus and test sequences. At times, certain of the hard keys are depicted on the screen. This indicates that these keys may be used.

2960 rear panel

See Fig. 3-2.

(17) DC in/out connectors. Used to connect a DC supply and for making power consumption measurements. The DC supply for the 2960 and/or for the unit under test is connected to the left-hand pair of terminals. The DC output to supply the unit under test is connected to the right-hand pair of terminals. In both cases the upper, red terminal is live and the lower, black terminal is connected to the chassis. The 2960's DC supply comes into operation when AC is not connected or when (1) is not ON.

(18) IF IN socket. BNC socket for connection from the 2955's IF OUT socket (29).

(19) AC supply voltage selector. To change the Adapter's AC range. The 2955's supply voltage selector (28) has to agree with this setting.

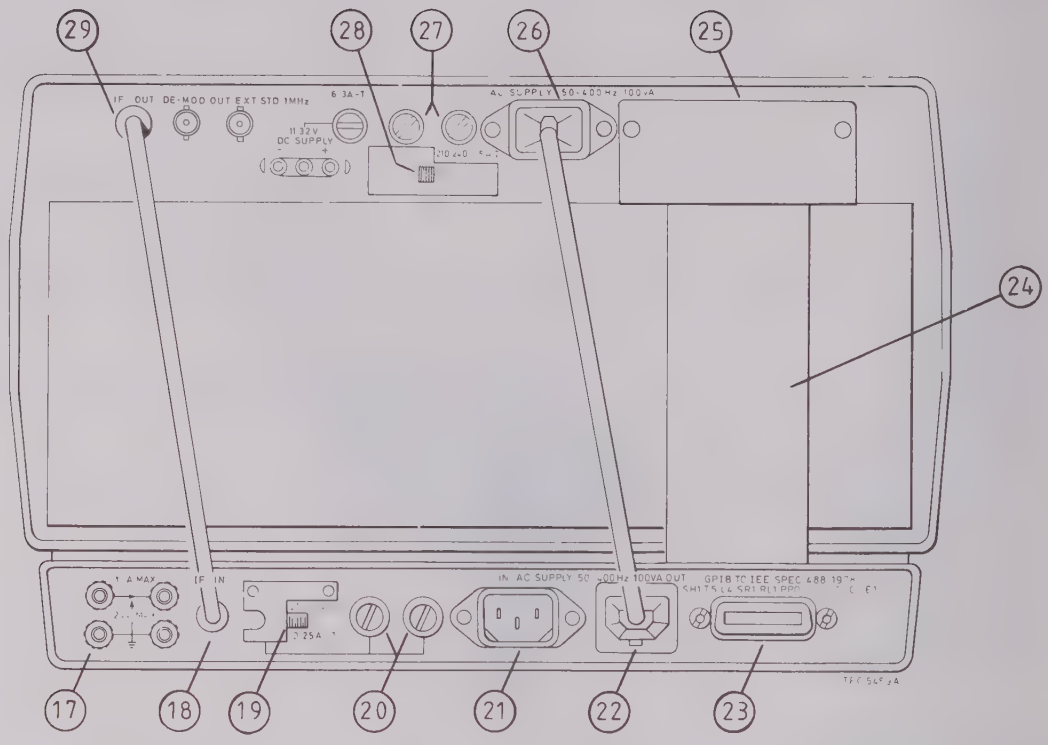

Fig. 3-2 2960 rear panel

(20) AC supply fuses. Time delay cartridge type for fusing the Adapter.

(21) AC SUPPLY IN connector. Supplies both the Adapter fused by (20) and the 2955 through the AC SUPPLY OUT socket (22).

(22) AC SUPPLY OUT connector. Supplies power to the 2955's AC SUPPLY connector (26).

(23) External GPIB connector. Enables the 2960 to be remotely controlled using the IEEE488 (or IEC625 with an adapter) bus. May also be used for the connection of a printer in listen only mode.

(24) Internal GPIB cable and connector. For connection to the 2955's GPIB connector (25).

(25) 2955 GPIB connector. For internal GPIB connector (24) which allows the Adapter to remotely control the 2955 using the IEEE488 bus.

(26) AC SUPPLY connector. Supplied with power from the Adapter's AC SUPPLY OUT connector (22). Fused by (27).

(27) AC supply fuses. Time delay cartridge type for fusing (26).

(28) AC supply voltage selector. To change the range. Has to be set to agree with the setting of the Adapter's supply voltage selector (19).

(29) IF OUT socket. BNC socket supplying a 110 ±10 kHz IF output to the Adapter's IF IN socket (18).

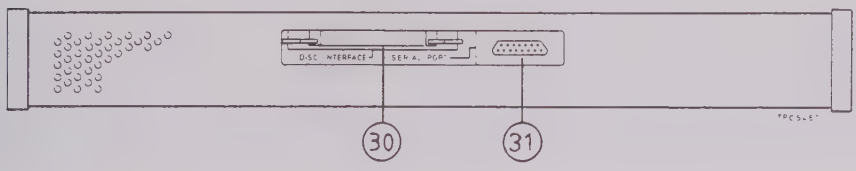

Fig. 3-3 Adapter side panel

Adapter side panel

See Fig. 3-3.

(30) DISC INTERFACE connector. For a floppy disc drive. Enables user-defined tests to be loaded into or saved from the Adapter's non-volatile memory.

(31) SERIAL PORT connector. Enables the 2960 to be remotely controlled from a terminal or computer using the RS-232 interface. May also be used for the connection of a printer with a suitable cable.

DISC OPERATION

A 3.5 or 5.25 inch, 40 or 80 track floppy disc drive can be connected. Single-sided or double-sided discs can be used but only 40 tracks on one side are used. Head stepping times of 6 or 12 ms can be selected; 6 ms is the default setting. These times refer to the inter-track stepping time, not the head settling time. For example, if the drive has a 10 ms step time, the time should be set to the next slower speed, i.e. 12 ms. Most modern drives are 3 or 6 ms.

Preparation

Connect the disc drive to its power supply and switch on. Connect the drive ribbon cable to the DISC INTERFACE connector. For connector compatiblity, see Chap. 2. Insert a disc in the drive slot and close the lock.

Press the DISC key. The **DISC CATALOGUE MENU** (or **DISC CATALOG MENU**) appears as shown in Fig. 3-4. The drive should start up.

If the message DISC FAULT appears, it indicates that the catalogue cannot be read as the disc has not been formatted or is faulty. If the message DRIVE NOT READY is shown, there has been no response from the drive. In either case, remove the disc drive cable, check the connections and supply and then reconnect the drive cable. Press CAT to re-attempt to read the disc catalogue. If DRIVE NOT READY is again shown, there is probably a fault with the disc drive. If NO DISC INSERTED is shown, insert or re-insert the disc and press CAT. If a file which has been recorded under a superseded software issue is loaded, a warning message is shown in reverse field at the bottom of the screen. An attempt to use this file may cause the system to malfunction and should be avoided.

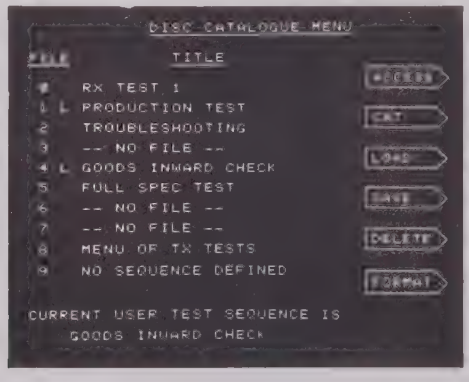

Fig. 3-4 **DISC CATALOGUE MENU**

The **DISC CATALOGUE MENU** shows files 0 to 9 together with their titles or NO FILE where appropriate. It shows all the disc functions using the ACCESS, CAT, LOAD, SAVE, DELETE and FORMAT soft keys. When a fault message is shown during operation, refer to 'Fault messages' in Table 3-1.

Formatting

Before a new blank disc can be used, it has to be formatted for the disc filing system. To do this, press the FORMAT key. FORMAT and ENTER flash on the display. As formatting automatically erases all previously saved files, the message DATA ON DISC WILL BE LOST, PRESS ENTER TO CONFIRM is shown. To abort the formatting process, press any other soft key except ENTER. Otherwise, press ENTER to confirm. Formatting takes place and, when completed, the catalogue is updated while CAT flashes.

When CAT stops flashing, NO FILE is shown against all ten files. Discs which have been formatted on 40 track disc drives are not interchangeable with those formatted on 80 track disc drives. On 80 track disc drives, only the first 40 tracks on the disc are formatted.

Saving

To save a file, press the SAVE key. SAVE flashes on the display and the file number is requested. Enter the file number using the keypad or abort by pressing any soft key. If a file already exists for that number, the message OVERWRITE EXISTING FILE? PRESS ENTER TO CONFIRM is shown and ENTER flashes. To abort the saving process, press any other soft key except ENTER. Otherwise, press ENTER (which changes to SAVE) to confirm. Saving on disc then takes place and when it is completed, the catalogue is updated while CAT flashes. When CAT stops flashing, the file name or NO SEQUENCE DEFINED is shown against the file number.

Loading

To load a file, press the LOAD key. LOAD flashes on the display and the file number is requested. Enter the file number using the keypad or abort by pressing any soft key. Loading to memory then takes place and when completed, LOAD stops flashing.

Deleting

To delete a file, press the DELETE key. DELETE flashes on the display and the file number is requested. Enter the file number using the keypad or abort by pressing any soft key. If no file is present under that number, the message FILE DELETED is shown. When a file is present, the message ABOUT TO DELETE FILE, PRESS ENTER TO CONFIRM is shown and ENTER flashes. To abort the deletion process, press any other soft key except ENTER. Otherwise, press ENTER (which changes to DELETE) to confirm. File deletion takes place and, when completed, the catalogue is updated while CAT flashes. When CAT stops flashing, --NO FILE-- is shown against the file number.

Locking

To lock a file to prevent it being overwritten by SAVE or deleted by DELETE or to unlock a previously locked file, press the ACCESS key. ACCESS flashes on the display and the file number is requested. Enter the file number using the keypad or abort by pressing any soft key. The catalogue is then updated while CAT flashes. When CAT stops flashing, the letter L is shown against the file number to indicate that it is now locked or, alternatively, the letter L is removed to show that the file has been restored to its normal unlocked state.

Catalogue

Normally, the catalogue is kept updated but, if the disc is changed, it is necessary to press the CAT key to read the catalogue. This is also necessary after a disc drive fault condition. While the catalogue is being updated, CAT flashes. When CAT stops flashing, the current catalogue is shown.

Fault messages

The fault messages, together with their meanings and suggested remedies, are listed in Table 3-1.

TABLE 3-1 DISC DRIVE FAULT MESSAGES

Fault message	Meaning	Remedy
DRIVE NOT READY	No response from drive	Check disc inserted correctly, check all connections, check power supply, replace faulty drive
NO DISC INSERTED	No disc is present or not correctly inserted in drive or lock not closed	Insert disc correctly and close lock
FILE DELETED	No file present	-
FILE LOCKED	File locked to prevent overwriting	Unlock using ACCESS key
DISC FAULT	(1) Disc not formatted or for different system	Format using FORMAT key
	(2) Discs formatted for 40 and 80 tracks are mixed	Separate different formats
	(3) Verification error (e.g. disc unreliable or dirty head)	Replace disc or clean head
	(4) Faulty drive	Repair or replace drive
	(5) Head misalignment between drives	Try another drive or use one drive for saving and loading
DISC CHANGED	Disc changed since updating of catalogue	Press CAT key for new catalogue
WRITE PROTECTED	Disc physically protected from overwriting	Remove physical protection

Chapter 3-2

REMOTE OPERATION

REMOTE CONTROL

The 2960 can be controlled remotely either from a GPIB controller or through the RS-232 serial interface.

The serial interface gives control from a dumb ASCII terminal, from a computer with a serial port or through a modem. In RS-232 operation, the commands are the same as for GPIB operation with the addition of commands which are specific to RS-232. For ease of use with a modem, the ECHO command can be used to cause any character which is sent to the 2960 to be echoed back to the terminal.

There are three remote control modes as follows:-

(a) Remote pass-through. To control the 2955.
(b) Remote CRTS immediate. To control the 2960.
(c) Remote CRTS learn. To enter a program.

The descriptions below assume that the controller is correctly connected and that the appropriate programming procedure is used. Refer to the manufacturer's literature.

Note...

Remote operation may be slowed down when data is being generated.

REMOTE PASS-THROUGH MODE

This mode can be entered by one of the following methods:-

(a) From 2955 local mode (i.e. the mode which is entered at switch-on), by the 2960 receiving either REMOTE from the GPIB or by any character appearing at the RS-232 input.

(b) From remote CRTS immediate mode, by receiving the program code NOrmal from the controller.

In this mode, the incoming data is routed straight to the 2955. The only data check is to see whether the input string contains the program code CRTS. When CRTS is received, the system enters the remote CRTS immediate mode.

When the 2960 is addressed to talk in GPIB operation, it similarly addresses the 2955 to talk and holds off the external bus until it has received the data from the 2955 and placed it in its output buffer. Holdoff is then released and the data is sent out.

In RS-232 control, the SRQ function on the 2955 has to be enabled so that the program knows when there is data ready to be sent out.

This mode can be exited by one of the following methods:-

(a) To 2955 local mode, by GTL from the GPIB or by the program code LOCal through the RS-232 input.

(b) To 2955 local mode, by pressing the LOCAL key on the Adapter's front panel.

(c) To remote CRTS immediate mode, by the program code CRTS from the controller.

For a summary of entering and exiting modes, see Fig. 3-5.

REMOTE CRTS MODES

These modes can be entered by one of the following methods:-

(a) From local CRTS mode, by the 2960 receiving REMOTE from the GPIB or by any character appearing at the RS-232 input.

(b) From remote pass-through mode, by the program code CRTS from the controller.

The 2960 goes into the remote CRTS immediate mode which is indicated by WAITING FOR RUN being shown on the display. At this point, changes can be entered as immediate mode commands which change the test sequence, format, etc. When run is initiated by <RETURN> (which is equivalent to pressing START TEST in local mode), this causes the test sequence which is displayed on the screen to be executed. The test sequence is that previously selected either from the **CHANGE FORMAT MENU** or by using the change procedure below.

When the program code LEarn is sent, followed by <RETURN>, the 2960 goes into the remote CRTS learn mode which is indicated by IN LEARN MODE being shown on the display. A program can then be entered, terminated with the program code END. Pressing <RETURN> redisplays the message WAITING FOR RUN. When required, the program can be saved on disc using the program code SAve.

The remote CRTS immediate mode can be exited by one of the following methods:-

(a) To local CRTS mode, by GTL from the GPIB or by the program code LOCal through the RS-232 input.

(b) To local CRTS mode, by pressing the LOCAL key on the Adapter's front panel.

(c) To remote pass-through mode, by the program code NORmal from the controller.

For a summary of entering and exiting modes, see Fig. 3-5.

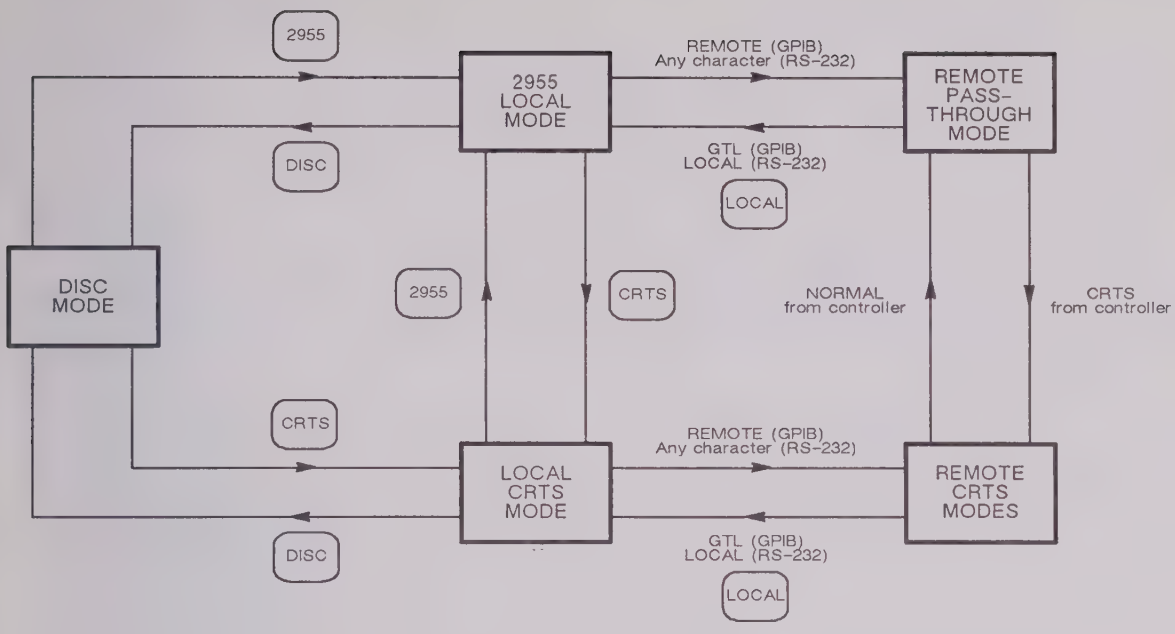

Fig. 3-5 Entering and exiting modes

PROGRAMMING

See the Programming Manual.

Chapter 4-1

BRIEF TECHNICAL DESCRIPTION

INTRODUCTION

The Radio Test System 2960 consists of a Radio Communications Test Set 2955 series with a Multi-system Adapter. See Fig. 4-1. For the brief technical description of the 2955, see Chap. 4-1 of the Operating Manual for the 2955.

Between the 2955 and the Adapter, there are three signal paths as follows:-

(a) The 2955's IF output signal is passed to the Adapter to be demodulated.

(b) The modulation signal which is generated by the Adapter is passed to the 2955 to modulate its RF output.

(c) The audio signal which is processed by the Adapter is passed to the 2955 to measure the level and/or the frequency.

ADAPTER BOARDS

The Adapter contains the following boards:-

(a) Motherboard A1.
(b) Keyboard A2.
(c) Keyboard interface board A3.
(d) Personality board B4/1.
(e) AC/DC power supply board A7.

MOTHERBOARD A1

The majority of the Adapter's functions are performed by the motherboard A1. The following circuits are included:-

(a) Microprocessor with system memories.
(b) System timer.
(c) GPIB interfaces (internal to 2955 and external).
(d) Disc control interface.
(e) Interfaces for the serial and parallel control ports.
(f) Demodulator.
(g) SAT generator.

KEYBOARD A2 AND KEYBOARD INTERFACE BOARD A2

The interface board A3 buffers the data from the keyboard A2 and transfers data in the other direction to illuminate the indicating LEDs above the four front-panel push-button switches.

PERSONALITY BOARD B4/1

The personality board B4 has its own memory which enables the Adapter to perform the functions which are specific to each transmission system. There is provision for up to six EPROMS, one for each of the options.

To cover all the transmission systems, the following circuits are included on this board:-

(a) FFSK and FSK modems.
(b) DTMF receiver and two generators.
(c) SAT and ST filters and detectors.
(d) De-emphasis filter.
(e) Psophometric filters.

For demodulation and for modulation, each modem converts between FFSK or FSK data and serial data. A USART converts between this serial data and the parallel data of the microprocessor.

For demodulation, the DTMF receiver converts tones into data for the microprocessor. For modulation, the DTMF generators convert data into tones.

Each SAT and ST filter passes its appropriate frequency which, when it is present, activates the relevant detector.

The de-emphasis and psophometric filters are used when noise measurements are to be made on an audio signal.

The appropriate circuits are connected to the motherboard A1 for the following signals:-

(a) Demodulated input signal from the motherboard A1.
(b) Modulation output signal to the motherboard A1.
(c) AF output signal to the motherboard A1, for measurement of level and/or frequency by the 2955.

AC/DC POWER SUPPLY BOARD A7

The AC supply is fed from the AC SUPPLY IN connector to the AC SUPPLY OUT connector and then through fuses, the SUPPLY ON switch and the voltage selector to a mains transformer. The two halves of the primary of the transformer are connected in series for 230 V and in parallel for 115 V.

One of the two secondary windings is connected to a full-wave rectifier on the power supply board A7.

The DC supply from the DC connectors and the output from the rectifier are fed to the contacts of a relay. When AC is present, the rectifier output is fed to another full-wave rectifier. When AC is not present, DC is fed to this rectifier.

A switching regulator supplies +5 V DC, +12 V DC and -12 V DC through an isolating transformer. Feedback is taken through an optical coupler.

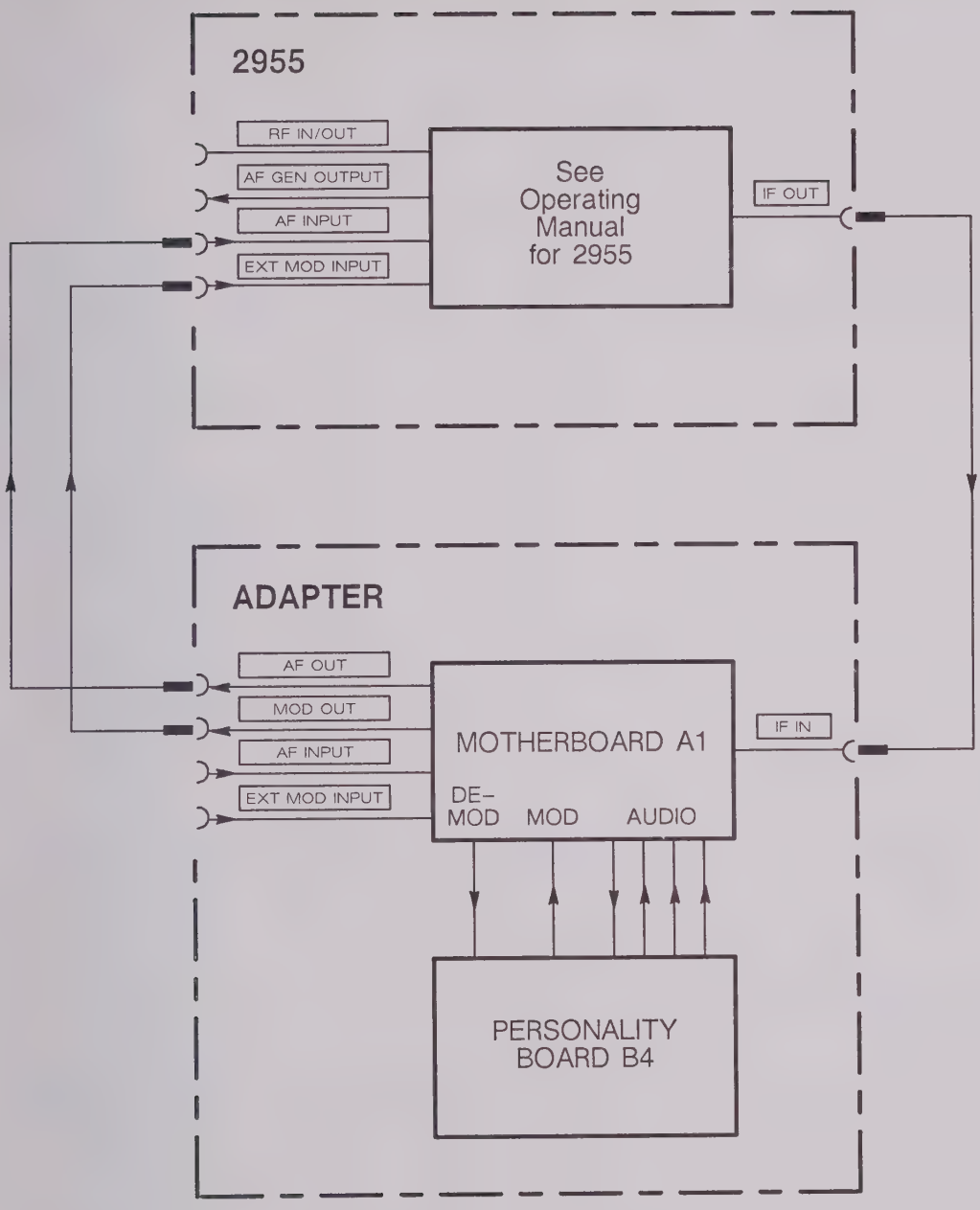

Fig. 4-1 Signal paths

Chapter 5

ACCEPTANCE TESTING

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SAT GENERATOR

These tests apply to NMT, AMPS and TACS only. When more than one of these systems are available in a single instrument, the tests are only necessary on one system as the circuitry is common.

Distortion

Specification:

SAT generator distortion	Less than 2% at 4 kHz ±45 Hz, less than 2% at 6 kHz ±30 Hz.

Test equipment:

Reference	Description	Minimum specification	Example
a	Distortion meter	3 to 8 kHz, measuring capability <0.2%	Marconi TF 2331A or HP 8903

Procedure:

(1) Switch on the instrument and press the CRTS key.

(2) When the equipment has completed its self-test, select MANUAL TEST.

(3) Select MANUAL TEST and, under MODE, select DATA OFF.

(4) Using the CHANGE key and the data keypad, set the SAT frequency to the first of the following frequencies:-

System	SAT frequencies
NMT	3955, 3985, 4015, 4045 Hz
AMPS	5970, 6000, 6030 Hz
TACS	5970, 6000, 6030 Hz

(5) Set the SAT level to 2.5 kHz and the data level to 0 kHz.

(6) Connect a 50 Ω termination to the Adapter's EXT MOD I/P socket (to cut out any pick-up). Connect the Adapter's MOD O/P socket to the distortion meter input.

(7) Measure the distortion, checking that it is within 2%. (If the 2331A distortion meter is used, the reference should be set on the 10% range due to the low level of output from the Adapter's MOD O/P socket.)

(8) Repeat for the other SAT frequencies.

Frequency and deviation accuracy

Specification:

Frequency range	3 to 8 kHz.
Frequency accuracy	±1 Hz.
Deviation accuracy	±10% for deviations of 300 Hz to 2.5 kHz at system frequencies (3.955 kHz to 4.045 kHz and 5.970 kHz to 6.030 kHz).

Test equipment:

Reference	Description	Minimum specification	Example
b	Counter/timer	Period measurement accuracy <5 parts/10^6	Marconi 2437
c	Modulation meter	RF in up to 1000 MHz FM, noise averaging, 50 Hz to 15 kHz filter, LF output	Marconi 2305

Procedure:

(1) Connect the 2955 RF IN/OUT N socket to the modulation meter RF input socket and connect the counter/timer to the modulation meter LF output socket as shown in Fig. 5-1.

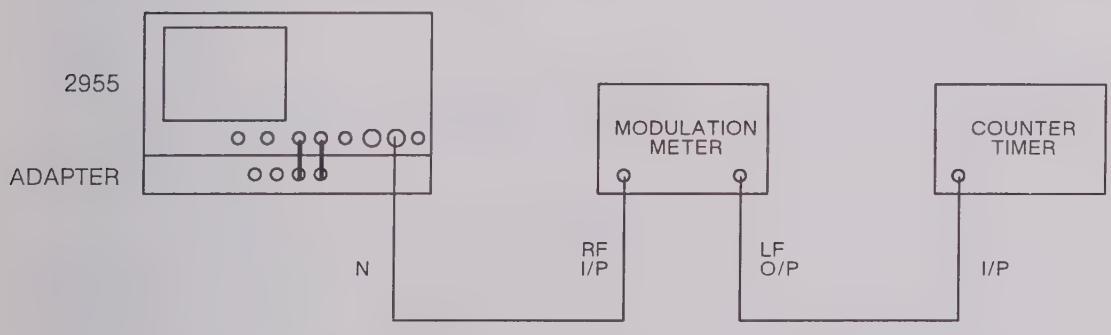

Fig. 5-1 Test equipment for SAT frequency and deviation tests

(2) Switch on the instrument and press the CRTS key.

(3) When the equipment has completed its self-test, select MANUAL TEST.

(4) Select MANUAL TEST and, under MODE, select DATA OFF.

(5) Using the CHANGE key and the data keypad, set the SAT generator to the first row of settings shown in Table 5-1 or Table 5-2, according to the system.

TABLE 5-1 SAT GENERATOR SETTINGS - NMT

SAT frequency	SAT level	Data level	Counter/timer limits
3955 Hz	0.3 kHz	0 kHz	252780.5 to 252908.4
3985 Hz	0.3 kHz	0 kHz	250878.1 to 251004.0
4015 Hz	0.3 kHz	0 kHz	249003.9 to 249128.0
4045 Hz	0.3 kHz	0 kHz	247157.6 to 247279.9

TABLE 5-2 SAT GENERATOR SETTINGS - AMPS AND TACS

SAT frequency	SAT level		Data level	Counter/timer limits
	AMPS	TACS		
5970 Hz	2 kHz	1.7 kHz	0 kHz	67476.2 to 167532.3
6000 Hz	2 kHz	1.7 kHz	0 kHz	166638.9 to 166694.5
6030 Hz	2 kHz	1.7 kHz	0 kHz	165809.9 to 165864.9

(6) The SAT modulated carrier level has to be increased for it to trigger the modulation meter. To achieve this, press 2955 and then RX. If the 2955 key is inadvertently pressed twice (indicated by the 2955 LED on and the CRTS led OFF), the SAT is switched off. (To recover, press CRTS, 2955 and RX).

(7) Set the modulation meter to monitor FM noise average in a 50 Hz to 15 kHz bandwidth. Set the LF level potentiometer to the brown marker (2305).

(8) Set the counter/timer to measure period on the ns range. (This is required to achieve the correct accuracy and resolution.)

(9) Check on the modulation meter that the deviation displayed is within ±10% of the set SAT deviation level.

(10) Check on the counter/timer that the period indicated is within ±1 Hz, (i.e. within the limits shown in the right hand column of the above tables).

Note... If problems are encountered triggering the counter/timer, return to manual operation and increase the SAT level to 2 kHz deviation to carry out the counter measurements. (To return to MANUAL mode, press the CRTS key.)

(11) Repeat the check for the other SAT frequencies.

SAT MEASUREMENT - NMT

This test applies to NMT450 and NMT900.

Specification:

Accuracy	±10% at nominal system SAT frequencies and level.

Test equipment:

Reference	Description	Minimum specification	Example
c	Modulation meter	400 to 1000 MHz FM, noise averaging, 50 Hz to 15 kHz filter, measurement accuracy <2%	Marconi 2305
d	Signal generator	450 to 1000 MHz, 13 dBm, external FM capability	Marconi 2019A
e	Synthesized LF generator	0 to 7 kHz, 1 V RMS	R & S SPN or HP 3325

Procedure:

Note... The Adapter measures SAT deviation in a very narrow bandwidth centred on the SAT frequency. Independent filters of this characteristic are not generally available. Therefore, the test method is written around a good quality modulation meter with an internationally recognized filter bandwidth and noise averaging selected.

(1) Connect the LF generator output socket to the signal generator external modulation input socket and connect the signal generator output socket to the modulation meter input socket as shown in Fig. 5-2.

(2) Set the LF generator to give an output of 4.015 kHz at a level suitable for the signal generator being used.

(3) Set the signal generator to a frequency of 456.350 MHz (NMT-450) or 893.3625 MHz (NMT-900), 300 Hz external deviation, RF level 13 dBm.

(4) Set the modulation meter to monitor FM in a 50 Hz to 15 kHz bandwidth with noise average selected.

(5) Note the deviation displayed on the modulation meter.

(6) Switch on the Adapter and press the CRTS key. When the equipment has completed its self-test, check that the correct system is selected (i.e. NMT-450 or NMT-900).

(7) Select MANUAL TEST.

(8) Set the channel to 135 and the mode to COMBINED CC/TC.

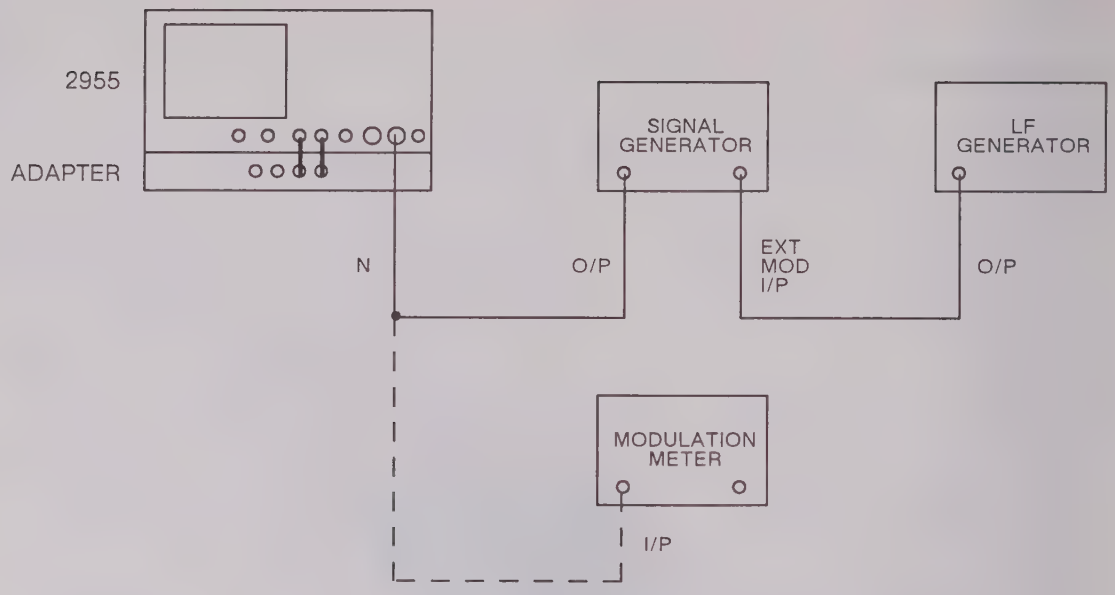

Fig. 5-2 Test equipment for SAT measurement test

(9) Using the CHANGE key and the data keypad, set the SAT generator frequency to the same frequency as that set on the LF generator. The CHANGE key should now have changed to NEXT and the flashing cursor should be under the SAT level.

(10) Press the NEXT key twice. The flashing cursor should disappear. (Although the SAT generator output is not actually used during this check, the SAT generator frequency has to be set always to the same frequency as that set on the LF generator in order to ensure that the correct internal calibration table is used.)

(11) Connect the signal generator output to the 2955 RF IN/OUT N socket.

(12) Check that ON appears in reverse on the screen and that the SAT level displayed is within ±10% of the deviation noted on the modulation meter.

(13) Repeat for LF generator frequencies of 3955, 3985 and 4045 Hz.

SAT MEASUREMENT - AMPS AND TACS

This test applies to AMPS and TACS.

Specification:

Accuracy	±10% at nominal system SAT frequencies and level.

Test equipment:

Reference	Description	Minimum specification	Example
c	Modulation meter	400 to 1000 MHz FM, noise averaging, 50 Hz to 15 kHz filter, measurement accuracy <2%	Marconi 2305
d	Signal generator	450 to 1000 MHz, 13 dBm, external FM capability	Marconi 2019A
e	Synthesized LF generator	0 to 7 kHz, 1 V RMS	R & S SPN or HP 3325

Procedure:

Note... The Adapter measures SAT deviation in a very narrow bandwidth centred on the SAT frequency. Independent filters of this characteristic are not generally available. Therefore, the test method is written around a good quality modulation meter with an internationally recognized filter bandwidth and noise averaging selected.

(1) Connect the LF generator output socket to the signal generator external modulation input socket and connect the signal generator output socket to the modulation meter input socket as shown in Fig. 5-3.

(2) Set the LF generator to give an output of 6 kHz at a level suitable for the signal generator being used.

(3) Set the signal generator to a frequency of 835.020 MHz (AMPS) or 898.0625 MHz (TACS), 2 kHz (AMPS) or 1.7 kHz (TACS) external deviation, RF level 13 dBm.

(4) Set the modulation meter to monitor FM in a 50 Hz to 15 kHz bandwidth with noise average selected.

(5) Note the deviation displayed on the modulation meter.

(6) Switch on the Adapter and press the CRTS key. When the equipment has completed its self-test, check that the correct system is selected (i.e. AMPS or TACS).

(7) Select MANUAL TEST.

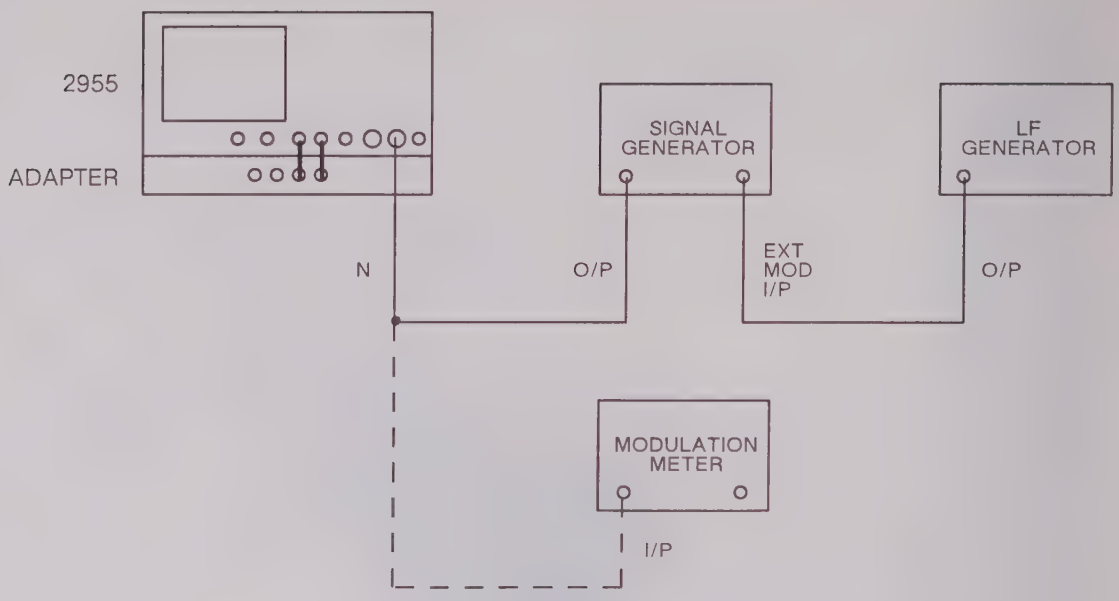

Fig. 5-3 Test equipment connections for SAT measurement test

(8) Set the channel to 323 and the mode to FCC.

(9) Using the CHANGE key and the data keypad, set the SAT generator frequency to the same frequency as that set on the LF generator. The CHANGE key should now have changed to NEXT and the flashing cursor should be under the SAT level.

(10) Press the NEXT key twice. The flashing cursor should disappear. (Although the SAT generator output is not actually used during this check, the SAT generator frequency has to be set always to the same frequency as that set on the LF generator in order to ensure that the correct internal calibration table is used.)

(11) Connect the signal generator output to the 2955 RF IN/OUT N socket.

(12) Check that SAT appears in reverse on the screen and that the SAT level displayed is within ±10% of the deviation noted on the modulation meter.

(13) Repeat for LF generator frequencies of 5.970 and 6.030 kHz.

PSOPHOMETRIC FILTER - CCITT

This test applies to NMT, TACS, and Band III.

Specification:

CCITT response	50 Hz to 300 Hz	±2 dB.
	300 Hz to 800 Hz	±1 dB.
	800 Hz reference	±0 dB ±0.2 dB.
	800 Hz to 3 kHz	±1 dB.
	3 kHz to 3.5 kHz	±2 dB.
	3.5 kHz to 5 kHz	±3 dB.

Test equipment:

Reference	Description	Minimum specification	Example
e	Synthesized LF generator	50 Hz to 5 kHz, 2 V RMS	R & S SPN or HP 3325
f	DVM	AC: RMS accuracy <0.5%, DC volts: 1 MΩ, accuracy <0.5%	Solatron 7150+ or Datron 1065A

Procedure:

(1) Connect the LF synthesizer output socket to the Adapter's AF INPUT socket and connect the Adapter's AF OUT socket to the DVM input socket as shown in Fig. 5-4.

Note... As short a lead as possible should be used from the Adapter's AF OUTPUT to the DVM as a long lead can cause the output to oscillate. If this problem still occurs during the test, connect a 470 Ω resistor in series with the AF OUTPUT. This does not affect the results of the test.

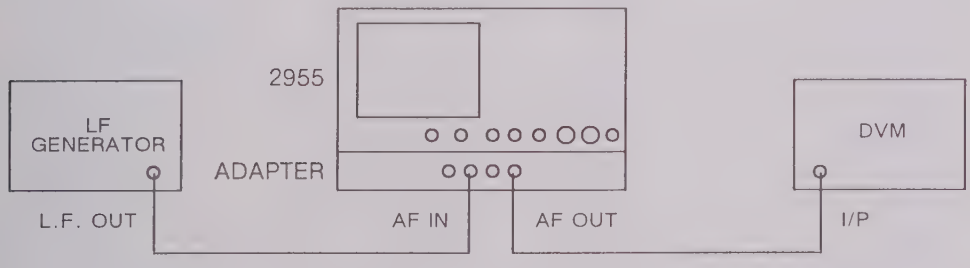

Fig. 5-4 Test equipment connections for psophometric filter test

(2) Switch on the equipment and check that the LED lights above the Adapter's 2955 key.

(3) Set the LF synthesizer to give an 800 Hz sinewave at 2 V RMS.

(4) Set the DVM to monitor AC voltage.

(5) Note the reading on the DVM (reading 1).

(6) Press the PSOH/LOCAL key and check that the LED above this key and that above the 2955 key are both on.

(7) Note the reading on the DVM (reading 2). This reading should be approximately 2 V. If the reading is approximately 1.7 V, this indicates that AMPS is selected and the C-message filter is in circuit. When this is the case, then either go to the C-message filter check or enter the CRTS mode and select one of the systems mentioned above.)

(8) Check that reading 2 is within 6% of reading 1. If not, R149 on the personality board B4 requires adjustment.

(9) With the LF generator at 800 Hz, adjust the LF generator output level until the DVM reads 2.000 V. This sets the reference at 800 Hz.

(10) Set the LF generator to each of the frequencies given in Table 5-3 and check that the DVM readings fall within the limits given in the right-hand column.

TABLE 5-3 CCITT FILTER RESPONSE

Frequency	Nominal level		DVM limits	
Hz	dB	V (2 V in)	dB	V
150	-29	0.07096	-31 to -27	0.05637 to 0.08934
200	-21	0.17825	-23 to -19	0.14159 to 0.2244
300	-10.6	0.5902	-12.6 to -8.6	0.4688 to 0.7430
400	-6.3	0.9683	-7.3 to -5.3	0.863 to 1.0865
500	-3.6	1.3214	-4.6 to -2.6	1.1777 to 1.4826
600	-2.0	1.5887	-3.0 to -1.0	1.4159 to 1.7825
800	0	2.000	Reference	Reference
1000	+1.0	2.244	0.0 to +2.0	2.000 to 2.5179
1200	0.0	2.000	-1.0 to +1.0	1.7825 to 2.244
1500	-1.3	1.72199	-2.3 to -0.3	1.5347 to 1.9321
2000	-2.0	1.5887	-3.0 to -1.0	1.4159 to 1.7825
2500	-4.2	1.2332	-5.2 to -3.2	1.099 to 1.3837
3000	-5.6	1.0496	-7.6 to -3.6	0.8337 to 1.3214
3500	-8.5	0.7517	-10.5 to -6.5	0.5970 to 0.9463
4000	-15	0.35565	-18.0 to -12.0	0.2518 to 0.5024
5000	-36	0.0317	-39.0 to -33.0	0.02244 to 0.0448

PSOPHOMETRIC FILTER - C-MESSAGE

This test applies to AMPS only.

Specification:

C-message response	60 Hz	55.7 ±2 dB.
	100 Hz	42.5 ±2 dB.
	200 Hz	25.0 ±2 dB.
	300 Hz	16.5 ±1 dB.
	400 Hz	11.4 ±1 dB.
	500 Hz	7.5 ±1 dB.
	600 Hz	4.7 ±1 dB.
	700 Hz	2.7 ±1 dB.
	800 Hz	1.5 ±1 dB.
	900 Hz	0.6 ±1 dB.
	1 kHz	0 reference.
	1.2 kHz	0.2 ±1 dB.
	1.3 kHz	0.5 ±1 dB.
	1.5 kHz	1.0 ±1 dB.
	1.8 kHz	1.3 ±1 dB.
	2.0 kHz	1.3 ±1 dB.
	2.5 kHz	1.4 ±1 dB.
	2.8 kHz	1.9 ±1 dB.
	3.0 kHz	2.5 ±1 dB.
	3.3 kHz	5.2 ±2 dB.
	3.5 kHz	7.6 ±2 dB.
	4.0 kHz	14.5 ±3 dB.
	4.5 kHz	21.5 ±3 dB.
	5.0 kHz	28.5 ±3 dB.
	Attenuation to increase thereafter at 12 dB/octave up to 60 dB.	

Test equipment:

Reference	Description	Minimum specification	Example
e	Synthesized LF generator	50 Hz to 5 kHz, 2 V RMS	R & S SPN or HP 3325
f	DVM	AC: RMS accuracy <0.5%, DC volts: 1 MΩ, accuracy <0.5%	Solatron 7150+ or Datron 1065A

Procedure:

(1) Connect the LF synthesizer output socket to the Adapter's AF INPUT socket and connect the Adapter's AF OUT socket to the DVM input socket as shown in Fig. 5-5.

Note... As short a lead as possible should be used from the Adapter AF OUTPUT to the DVM as a long lead can cause the output to oscillate. If this problem still occurs during the test, connect a 470 Ω resistor in series with the AF OUTPUT. This does not affect the results of the test.

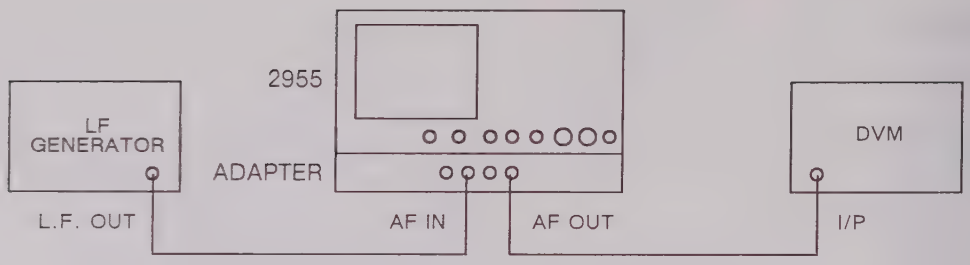

Fig. 5-5 Test equipment connections for psophometric filter test

(2) Switch on the equipment and check that the LED lights above the Adapter's 2955 key.

(3) Set the LF synthesizer to give a 1 kHz sinewave at 2 V RMS.

(4) Set the DVM to monitor AC voltage.

(5) Note the reading on the DVM (reading 1).

(6) Press the PSOH/LOCAL key and check that the LED above this key and that above the 2955 key are both on.

(7) Note the reading on the DVM (reading 2). This reading should be approximately 2 V. (If the reading is approximately 1.7 V, this indicates that a system other than AMPS is selected and the CCITT filter is in circuit. When this is the case, then either go to the CCITT filter check or enter the CRTS mode and select AMPS.

(8) Check that reading 2 is within 6% of reading 1. If not, R170 on the personality board B4 requires adjustment.

(9) With the LF generator at 1 kHz, adjust the LF generator output level until the DVM reads 2.000 V. This sets the reference at 1 kHz.

(10) Set the LF generator to each of the frequencies given in Table 5-4 and check that the DVM readings fall within the limits given in the right-hand column.

TABLE 5-4 C-MESSAGE FILTER RESPONSE

Frequency Hz	Nominal level dB	V (2 V in)	DVM limits dB	V
90	-44.3	0.01219	-46.3 to -42.3	0.00968 to 0.01535
200	-25	0.11247	-27.0 to -23.0	0.0893 to 0.1416
300	-16.5	0.29925	-17.5 to -15.5	0.2667 to 0.3358
400	-11.4	0.53831	-12.4 to -10.4	0.47946 to 0.60399
500	-7.5	0.84339	-8.5 to -6.5	0.7516 to 0.9463
600	-4.7	1.16421	-5.7 to -3.7	1.037 to 1.3063
700	-2.7	1.46565	-3.7 to -1.7	1.3063 to 1.6445
800	-1.5	1.68279	-2.5 to -0.5	1.4998 to 1.888
900	-0.6	1.86651	-1.6 to +0.4	1.6635 to 2.094
1000	0	2.0000	Reference	Reference
1200	-0.2	1.95447	-1.2 to +0.8	1.7419 to 2.193
1300	-0.5	1.88812	-1.5 to +0.5	1.4998 to 2.1185
1500	-1.0	1.7825	-2.0 to 0.0	1.5886 to 2.0000
1800	-1.3	1.72199	-2.3 to -0.3	1.5347 to 1.932
2000	-1.3	1.72199	-2.3 to -0.3	1.5347 to 1.932
2500	-1.4	1.70227	-2.4 to -0.4	1.517 to 1.91
2800	-1.9	1.70705	-2.9 to -0.9	1.432 to 1.803
3000	-2.5	1.49979	-3.5 to -1.5	1.336 to 1.683
3300	-5.2	1.09908	-7.2 to -3.2	0.873 to 1.384
3500	-7.6	0.83374	-9.6 to -5.6	0.662 to 1.0496
4000	-14.5	0.37673	-17.5 to -11.5	0.2667 to 0.532
4500	-21.5	0.16828	-24.5 to -18.5	0.119 to 0.2377
5000	-28.5	0.07516	-31.5 to -25.5	0.0532 to 0.1062

1200 BAUD FFSK GENERATOR

This test applies to NMT and Band III only. The modem is tested during the instrument self-test. This can be used as an independent check when required.

Specification:

FFSK (Phase continuous, frequency shifted tones of 1200 Hz and 1800 Hz) -

Deviation	±10% at 1 kHz to 4 kHz.
Data rate	1200 baud ±1 bit per second.

Test equipment:

Reference	Description	Minimum specification	Example
b	Counter/timer	Period measurement, ns range accuracy <±5 parts/10^6	Marconi 2437
c	Modulation meter	150 to 1000 MHz FM, noise averaging, LF output, measurement accuracy <2%	Marconi 2305

Procedure:

(1) Connect the 2955 RF IN/OUT N socket to the modulation meter RF input socket and connect the modulation meter LF output to the counter/timer input socket as shown in Fig. 5-6.

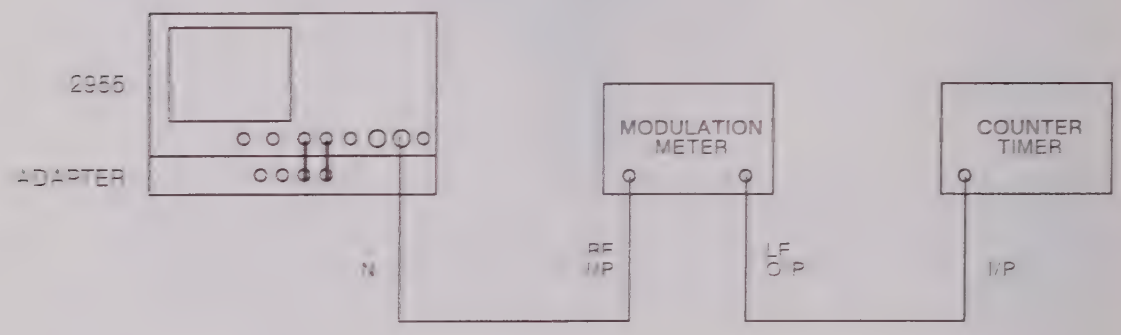

Fig. 5-6 Test equipment connections for 1200 baud FFSK generator test

(2) Switch on the Adapter on and press the CRTS key.

(3) When the Adapter has finished its self-test, check that the system selected is either NMT or Band III. If this is not the case, then select one of these systems before continuing.

(4) Select MANUAL TEST and the 1200 Hz mode. Set the data level to 3.5 kHz (NMT) or 1.5 kHz (Band III).

(5) The data modulated carrier level has to be increased for it to trigger the modulation meter. To achieve this, press 2955 and then RX. If the 2955 key is inadvertently pressed twice, the data is switched off. (To recover, press CRTS, 2955 and RX).

(6) In this mode, the carrier frequency reverts to a default value. When it is required to check the data deviation on a particular channel, set the RF generator to the corresponding channel frequency.

(7) Set the modulation meter to monitor FM noise average in a 0.3 to 3.4 kHz bandwidth. Set the LF level potentiometer to the brown marker (2305).

(8) Set the counter/timer to measure period on the ns range. (This is required to achieve the correct accuracy and resolution.)

(9) Check on the modulation meter that the deviation displayed is within ±10% of that set.

(10) Check on the counter that the frequency indicated is 1200 Hz ±1Hz.

(11) Repeat with the mode set to 1800 Hz and then with the mode set to DOTTING. Note that when the mode is set to dotting, the frequency on the counter appears as 1500 Hz. (To return to MANUAL mode, press the CRTS key.)

FSK AND MANCHESTER DATA GENERATOR

This test applies to AMPS and TACS only. The modem is tested during the instrument self-test. This can be used as an independent check when required.

Specification:

Manchester encoded NRZ data -

Deviation	±10% from 1 kHz to 10 kHz.
Data rate	± 1 bit per second at 10 kHz (AMPS) or 8 kHz (TACS).

Test equipment:

Reference	Description	Minimum specification	Example
b	Counter/timer	Period measurement, ns range accuracy <±5 parts/10^6	Marconi 2437
c	Modulation meter	150 to 1000 MHz FM, noise averaging, LF output, measurement accuracy <2%	Marconi 2305

Procedure:

(1) Connect the 2955 RF IN/OUT N socket to the modulation meter RF input socket and connect the modulation meter LF output to the counter/timer as shown in Fig. 5-7.

(2) Switch on the Adapter on and press the CRTS key.

(3) When the Adapter has finished its self-test, check that the system selected is AMPS or TACS. If this is not the case, then select one of these systems before continuing.

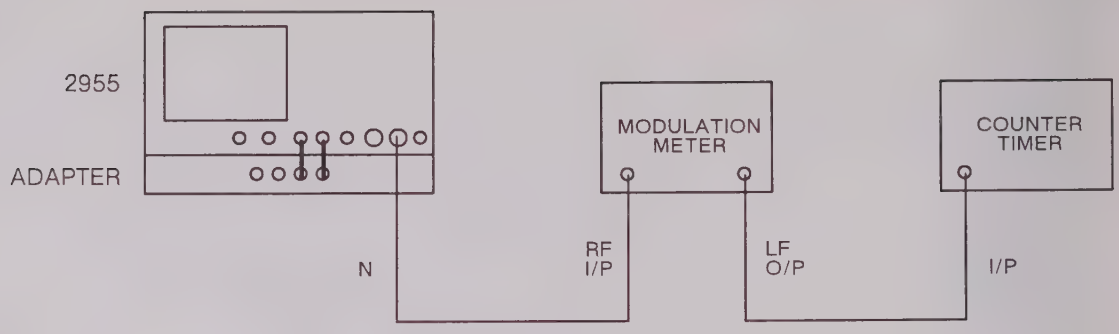

Fig. 5-7 Test equipment connections for FSK and Manchester data generator test

(4) Select MANUAL TEST and the signal tone mode. Set the data level to 8 kHz (AMPS) or 6.4 kHz (TACS).

(5) The data modulated carrier level has to be increased for it to trigger the modulation meter. To achieve this, press 2955 and then RX. If the 2955 key is inadvertently pressed twice, the data is switched off. (To recover, press CRTS, 2955 and RX).

(6) In this mode, the carrier frequency reverts to a default value. If it is required to check the data deviation on a particular channel, set the RF generator to the corresponding channel frequency.

(7) Set the modulation meter to monitor FM noise average in a 50 Hz to 15 kHz bandwidth. Set the LF level potentiometer to the brown marker (2305).

(8) Set the counter/timer to measure period on the ns range. (This is required to achieve the correct accuracy and resolution.)

(9) Check on the modulation meter that the deviation displayed is within ±10% of that set.

(10) Check on the counter that the frequency indicated is 100000 ns ±10 ns (AMPS) or 125000 ns ±16 ns (TACS).

DC METER

These tests are for voltage, current and power measurement accuracy.

Specification:

Voltmeter	±5% ±100 mV at 1 to 25 V.
Ammeter	±5% ±200 mA at 0 to 10 A.
Power meter	±10% ±20 mW at 100 mW to 200 W.

Test equipment:

Reference	Description	Minimum specification	Example
f	DVM	DC volts: 1 MΩ, accuracy <0.5%	Solatron 7150+ or Datron 1065A
g	Rheostat	0 to 100 Ω. 10 A	Berco
h	DC power supply	0 to 25 V, 10 A	Farnell B30/10
j	DVM current shunt	10 A, 0.25% accuracy, sensitivity 10 mV/A	Fluke 80J-10

Procedure:

(1) Connect the DC power supply to the Adapter's DC IN connectors, connect the DVM to the same connectors and connect the rheostat across the Adapter's DC OUT connectors as shown in Fig. 5-9.

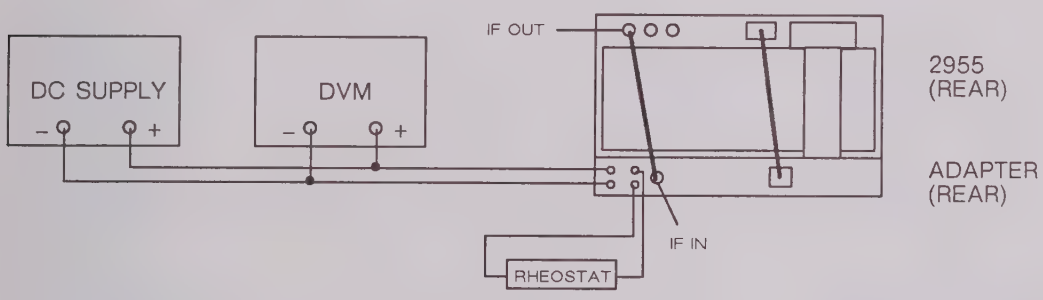

Fig. 5-8 Test equipment connections for DC meter test

(2) Switch on the equipment and press the CRTS key.

(3) When the instrument has completed its self-test, select MANUAL TEST.

(4) Adjust the rheostat to give a load resistance of 10 Ω.

(5) Set the DVM to read DC volts and then adjust the DC power supply to give a 10.00 V reading on the DVM.

(6) Check that the voltage displayed on the screen is within ±5% ±100 mV of the voltage indicated on the DVM.

(7) Check that the power reading displayed on the screen is equal to the current reading multiplied by the voltage reading.

(8) Repeat for voltages between 1 V and 25 V.

(9) Switch off the DC supply, disconnect the DVM and connect the current shunt across its inputs. Then reconnect the DVM in series with the positive supply as shown in Fig. 5-9.

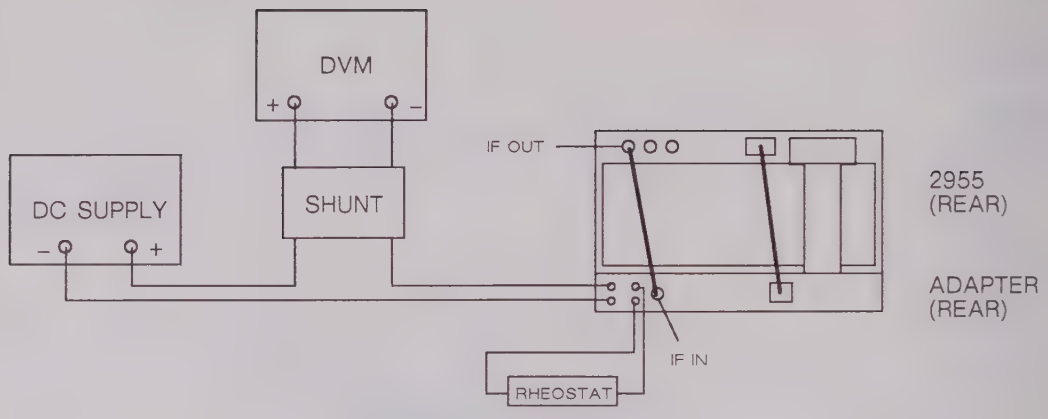

Fig. 5-9 Test equipment connections for DC meter test

(10) Set the rheostat to give a load resistance of 5 Ω.

(11) Set the DC power supply to give an output of 10 V and switch it on.

(12) Adjust the rheostat until the DVM indicates 20.0 mV (2 A).

(13) Check that the current reading displayed on the screen is within ±5% ± 200 mA of the current indicated on the DVM. (Every 10 mV displayed on the DVM is equivalent to 1 A.)

(14) Using the rheostat to adjust the current, repeat for DC levels on the DVM from 10 mV to 100 mV (1 A to 10 A).

EXTERNAL MODULATION

This test is for external modulation sensitivity.

Specification:

Sensitivity	0.5 V p-p for 5 kHz deviation ±10% at 1 kHz.

Test equipment:

Reference	Description	Minimum specification	Example
c	Modulation meter	300 Hz to 3.4 kHz filter, LF output, measurement accuracy <2%	Marconi 2305
e	Synthesized LF generator	1 kHz, 0.5 V pk-pk	R & S SPN or HP 3325
f	DVM	AC: RMS accuracy <0.5%,	Solatron 7150+ or Datron 1065A

Procedure:

(1) Connect the LF generator to the Adapter's EXT MOD INPUT socket and the DVM and connect the 2955 BNC RF IN/OUT socket to the modulation meter input socket as shown in Fig. 5-11.

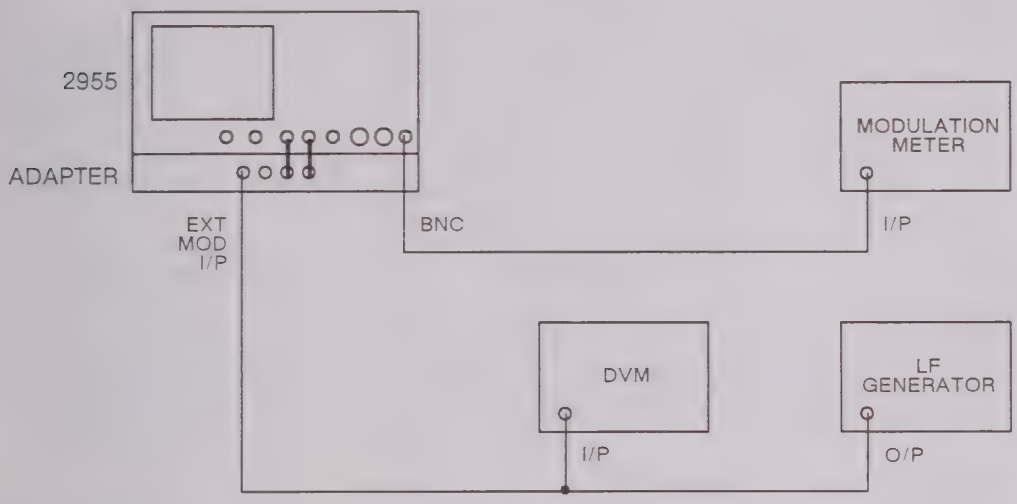

Fig. 5-10 Test equipment connections for external modulation test

(2) Switch on the equipment and check that the LED lights above the Adapter's 2955 key.

(3) Select RX mode and the RF IN/OUT BNC socket. Set the signal generator to a carrier frequency of 100 MHz, RF level to 0 dBm, modulation to 1 kHz, deviation level to 0 kHz, distortion to off and SINAD-S/N to off.

(4) Set the DVM to monitor AC volts RMS.

(5) Set the modulation meter to monitor FM with the 300 Hz to 3.4 kHz filter selected.

(6) Set the LF generator to give a 1 kHz sinewave output and adjust the level to give an RMS reading on the DVM of 176.7 mV.

(7) Check that the modulation meter reads 5 kHz deviation ±10%.

DISC DRIVE INTERFACE

The most convenient method of checking the performance of the disc drive interface is to ensure that a disc can be formatted correctly.

Specification:

Disc drive interface	Compatible with 3.5 or 5.25 inch, 40 or 80 track, single-sided or double-sided, single density disc drive with industry standard S.400 (Shugart) controller drive interface. Track to track stepping times of 6 and 12 ms are selectable.

Procedure:

(1) Insert a blank disc into the disc drive.

(2) Connect the disc drive to the DISC INTERFACE port on the right-hand side of the Adapter.

(3) Switch on the equipment.

(4) Press the DISC key to enter the DISC MENU. The Adapter attempts to read the disc directory. As the disc has not yet been formatted, DISC FAULT is displayed.

(5) Press the FORMAT key. The screen now displays DATA ON DISC WILL BE LOST PRESS ENTER TO CONFIRM.

(6) Press ENTER. When formatting has been completed, check that a catalogue of ten files is shown with NO FILE against each file.

SERIAL CONTROL PORT

In this test, two RF generator frequency settings (199 and 400 MHz) are checked by means of a program which is sent to the serial control port.

Specification:

Data rate	75 to 9600 baud.
Length	8 or 7.
Parity	Even, odd or none.
Stop bits	1 or 2.

Test equipment:

Reference	Description	Minimum specification	Example
k	Controller with serial interface	RS-232 compatible with selectable start, stop and parity	HP85 with serial interface

Procedure:

(1) Connect the RS-232 controller to the Adapter's SERIAL PORT.

(2) Enter the SERIAL INTERFACE MENU and set a BAUD RATE of 4800, LENGTH/PARITY to 8/EVEN and STOP BITS to 2.

(3) Enter and run a program which sets the 2955 RF generator to a specific frequency and then reads back the RF generator frequency to check that the command has been accepted and carried out. As an example, the following program is in HP-BASIC for an HP85 GPIB Controller:-

```
 10 RESET 10                                  Resets controller serial
                                              control port.
 20 SET TIMEOUT 10;5000
 30 ON TIMEOUT 10 GOTO 330                    If any of the input/output
                                              commands take more than 5 s
                                              to complete (e.g. due to
                                              problem with controller
                                              connector or Adapter),
                                              program pauses and indicates
                                              a timeout has taken place.
 40 CONTROL 10,3 ; 13,31,0                    Sets up controller serial
                                              port for 4800 baud rate,
                                              8-bit word length, even
                                              parity, 2 stop bits.
 50 WAIT 500
 60 OUTPUT 10 "CRTS" @ WAIT 1000              Commands Adapter to go into
                                              CRTS mode.
 70 OUTPUT 10 "RD1"
 80 ENTER 10 ; R$                             Performs a read command on
                                              the Adapter's serial buffer
                                              (to ensure that the buffer is
                                              empty).
 90 CLEAR @ DISP "SETTING 400MHz FREQUENCY"   Clears controller screen and
                                              then displays SETTING 400 MHz
                                              FREQUENCY.
100 OUTPUT 10 "COM RGFR400MZ"                 Commands Adapter to set an RF
                                              generator frequency of
                                              400 MHz.
110 OUTPUT 10 "NO"                            Sets Adapter into 2955 mode
                                              so that RF generator
                                              frequency can be seen on 2955
                                              screen.
120 WAIT 5000                                 Program halts for 5 s.
130 OUTPUT 10 "CRTS"                          Commands Adapter back to CRTS
                                              mode.
```

```
140 OUTPUT 10 "RD27"                                  Commands Adapter to put its
                                                      RF generator frequency
                                                      setting into its serial
                                                      output buffer.
150 ENTER 10 ; R$                                     Reads Adapter buffer.
155 R$=R$[1,12]
160 DISP
170 DISP "SET 400MHz ; READ ";R$                      On controller screen,
                                                      displays RF generator
                                                      frequency set and RF
                                                      generator frequency read.
180 P=1 @ IF R$ <> "400.00000MHz" THEN P=0            Compares frequency set with
                                                      frequency read.  If not the
                                                      same, pass/fail flag is set
                                                      to fail.
190 DISP @ DISP "SETTING 199MHz FREQUENCY"            190 to 290 same as 90 to 180
200 OUTPUT 10 "COM RGFR199MZ"                         except frequency is 199 MHz.
210 OUTPUT 10 "NO"
220 WAIT 5000
230 OUTPUT 10 "CRTS"
240 OUTPUT 10 "RD27"
250 ENTER 10 ; R$
255 R$=R$[1,12]
260 DISP
270 DISP "SET 199MHz ; READ ";R$
280 IF R$<> "199.00000MHz" THEN P = 0
290 IF P=1 THEN P$ = "Passed" ELSE P$ = "Failed"
300 BEEP 20,100 @ WAIT 100 @ BEEP 20,100             Audio indication from
                                                      controller to inform test is
                                                      complete.
310 DISP @ DISP "TEST" ; P$                           Displays on controller screen
                                                      TEST PASSED or TEST FAILED
                                                      depending on pass/fail flag.
320 END                                               End of program.
330 DISP "TIMEOUT" @ BEEP @ PAUSE
```

PARALLEL CONTROL PORT

In this test, the data accuracy is checked by means of a program which is used to read and write to and from the parallel control port.

Specification:

Parallel control port	Centronics type 8 way bi-directional port. 4 TTL outputs (unprotected). 4 TTL inputs (unprotected). +5 V DC supply at 100 mA accessory power (unprotected).

Test equipment:

Reference	Description	Minimum specification	Example
m	Oscilloscope	DC to 5 V display	Tektronix 2235
n	GPIB controller	GPIB output port	HP85 with GPIB or 82937A

Procedure:

(1) Connect the GPIB controller to the public GPIB socket on the rear of the Adapter.

(2) Enter the GPIB INTERFACE MENU. Set the PUBLIC GPIB ADDRESS to 06 and the GPIB function to TALKER/LISTENER.

(3) Prepare a terminator as shown in Fig. 5-11. This is to be used as instructed on the controller display during the program. The terminator should not be used until asked for as the first checks would fail.

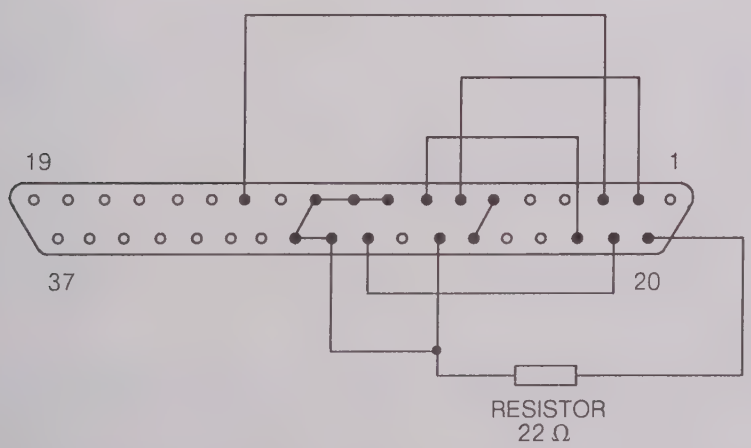

Fig. 5-11 Terminator connections for parallel control port test

(4) To enable the parallel control port to be written to and read from, either a GPIB or RS232C controller is required. The control program can then be either loaded as a user-defined program and stored on disc, if required, or the controller can directly command the parallel port. As an example, the following program is for an HP 85 GPIB Controller to directly control the port:-

```
10 PRINT "PARALLEL PORT CHECKS"
20 PRINT "=====================" 
30 PRINT
40 OUTPUT 706 ;"POI96,64"

50 WAIT 1000
60 OUTPUT 706 ;"POI88,255"
70 CLEAR
80 DISP "BI-DIRECTIONAL PORT
   OUTPUT CHECK";
90 DISP ;"------------------
   ------------";
100 DISP
110 DISP ;" USE THE OSCILLOSCOPE
   TO CHECK CONNECTOR PINS 6,
   9,10,11,25,26,29,30 ARE ALL
   LOW";
120 DISP ;"WITH RESPECT TO GROUND
   PIN 27"
130 DISP
140 DISP "CHECK FOR 5 VOLTS BETWEEN
   THE SUPPLY OUT PIN 1 AND
   GROUND PIN 27"
150 DISP
160 DISP "PRESS <CONT> WHEN READY"
170 BEEP @ PAUSE
180 CLEAR
190 DISP "BI-DIRECTIONAL PORT OUTPUT
   CHECK";
200 DISP "-------------------------
   -----"
210 DISP
220 DISP "USE THE OSCILLOSCOPE
   TO CHECK CONNECTOR PINS 6,9,
   10,11,25,26,29,30 ARE ALL
   HIGH"
230 DISP "WITH RESPECT TO GROUND
   PIN 27"
240 DISP
250 DISP "PRESS <CONT> WHEN READY"
260 OUTPUT 706 ;"POI88,000"
270 BEEP @ PAUSE
280 GOSUB 800
290 IF A$="000" THEN LET H$="PASSED"
300 IF A$<>"000" THEN LET H$="FAILED"
   @ BEEP 500,50 @ BEEP 800,50
310 CLEAR
320 DISP "BI-DIRECTIONAL PORT INPUT
   CHECK";
330 DISP "-------------------------
   ------"
```

First, 8-bit bidirectional port is checked.

Sets bi-directional port to output data mode.

Sets all 8 bits low (inverted).

User is asked to check for a low on each line using oscilloscope.

User is asked to check for +5 V.

User is asked to check that all lines are high. This checks that the port can output data correctly.

Sets all port lines high (inverted.)

Bi-directional port is checked to ensure that it reads data correctly. With nothing connected to the control lines, they float high. Controller reads port and ensures that result is 000 (inverted).

```
340 DISP
350 PRINT "BI-DIRECTIONAL PORT"
360 PRINT @ PRINT" SET READ
    PASS/FAIL"
370 PRINT "------------------------
    ---------"
380 A1$="000"
390 PRINT USING 400 ; A1$,A$,H$
400 IMAGE XX,3A,6X,3A,8X,6A
410 DISP "CONNECT A CONNECTOR
    CONFIGURED AS IN DIAGRAM TO THE
    PARALLEL CONTROL PORT."
420 DISP
430 DISP "PRESS <CONT> WHEN READY"
440 BEEP @ PAUSE
450 GOSUB 800
460 IF A$="255" THEN H$="PASSED"
    ELSE H$="FAILED" @ BEEP 500,
    50 @ BEEP 800,50
470 CLEAR
480 DISP "BI-DIRECTIONAL PORT INPUT
    CHECK";
490 DISP; "------------------------
    -----";
500 DISP
510 A1$="255"
520 PRINT USING 400; A1$,A$,H$
530 DISP
540 PRINT
550 T=0
560 T$="0"
570 CLEAR
580 DISP "TTL CONTROL CHECK"
590 OUTPUT 706 ;"POI96,255"
600 WAIT 200
610 GOSUB 890
620 PRINT "TTL CHECK HIGH";
630 IF T=255 THEN PRINT "PASSED"
    ELSE PRINT "FAILED" @ BEEP
    500,50 @ BEEP 800,50
640 PRINT
650 OUTPUT 706 ;"POI96,000"
660 GOSUB 890
670 PRINT "TTL CHECK LOW";
680 IF T=16 THEN PRINT "PASSED"
    ELSE PRINT "FAILED" @ BEEP 500,
    50 @ BEEP 800,50
690 PRINT
700 CLEAR
710 PRINT
720 PRINT "       TEST COMPLETE
    "
730 BEEP @ BEEP
740 DISP " TEST COMPLETE REMOVE
    CONNECTOR"
750 FOR X=1 TO 5
760 PRINT
770 NEXT X
```

User is asked to connect a terminator to the parallel control port. This pulls the 8 bi-directional port lines low. Also, 4 TTL outputs are routed to 4 TTL inputs.

Controller reads port and ensures that result is 255.

Sets the four TTL output lines high.

Controller reads 4 TTL inputs and checks result.

Sets the four TTL output lines low. Controller reads 4 TTL inputs and checks result.

```
780 LOCAL 706
790 END
800 FOR X=1 TO 3
810 OUTPUT 706 "POI96,16" @ OUTPUT
    706 "POI96,80"
820 OUTPUT 706 "PEI88"
830 WAIT 200
840 ENTER 706 ; R$
850 WAIT 200
860 IF X=3 THEN LET A$=R$
870 NEXT X
880 RETURN
890 ! TTL IN/OUT CHECK
900 FOR X=1 TO 3
910 WAIT 200
920 OUTPUT 706 ;"PEI96"
930 WAIT 200
940 ENTER 706 ; T$
950 IF X=1 OR X=2 THEN GOTO 970
960 LET T=VAL(T$)
970 NEXT X
980 RETURN
990 END
```

Sets the bi-directional port to read data.

Reads the result of the bi-directional post (3 times to obtain correct result).

Reads the result of the four TTL inputs.

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